Vol. 15, No. 16
August 31, 1990

Energy Research Abstracts

Abstracts 36689–38347

Office of Scientific and Technical Information
UNITED STATES DEPARTMENT OF ENERGY

The Office of Scientific and Technical Information

The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through the Energy Data Information System (EDIS) maintained by OSTI. The major databases in this system are available within the United States through commercial online systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major databases plus a number of specialized databases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

UNITED STATES DEPARTMENT OF ENERGY
Office of Scientific and Technical Information
Post Office Box 62
Oak Ridge, Tennessee 37831

International Copyright, © U.S. Department of Energy, 1990, under the provisions of the Universal Copyright Convention.
United States copyright is not asserted under the United States Copyright Law, Title 17, United States Code.

Vol. 15, No. 16
August 31, 1990
ISSN: 0160-3604
CODEN: ERABD

Energy Research Abstracts

Purpose

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U.S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. Foreign information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. **Please note that *ERA* coverage of nonreport literature is limited to that generated by Department of Energy activity.**

Scope

ERA is comprehensive in its subject scope, encompassing DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

The citations presented in *ERA* are available for online searching as records within the Energy Data Base. The current-year records are available on the Integrated Technical Information System (ITIS). The entire database is available through commercial online vendors.

Availability

DOE and DOE contractors who have OSTI deposit accounts can obtain *ERA* (regular issues and annual indexes) from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831, Attention: Information Services. For further information, call (615)576-8401, FTS 626-8401. *ERA* is also available at authorized GPO Depository Libraries. (List is provided on the inside back cover.)

ERA is available to the public on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The subscription rate for 24 semimonthly issues is $184.00 for domestic subscribers and $230.00 for foreign subscribers. A single issue costs $27.00, domestic, or $33.75, foreign. Cumulative indexes are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The GPO Stock Number is 061-000-00749-1 for the Volume 14 indexes.

Managing Editor, Audrey B. Smith
Technical Editor, Robert W. Rutkowski

Information Sources

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

The **Energy Technology Data Exchange (ETDE)** was established by the International Energy Agency to promote cooperation among members in conducting appropriate energy-related research and development programs through the development of a formal central information sharing system. In accomplishing the objectives of the ETDE, members select, abstract, and index relevant research information published in their countries in accordance with Exchange standards. OSTI serves as the central receiving and processing center for this information, which it then disseminates to national centers in the participating countries. The following countries are currently members of the ETDE:

- Canada
- Denmark
- Finland
- France
- Federal Republic of Germany
- Italy
- Japan
- The Netherlands
- Norway
- Spain
- Sweden
- Switzerland
- United Kingdom
- United States

The **International Nuclear Information System (INIS)** was established to promote the exchange of information on nuclear science and technology. Its operation is similar to that of the ETDE, with the INIS Secretariat being located in Vienna, Austria. Currently, 75 countries and 14 international organizations are members of INIS. OSTI serves as the INIS national center for the United States.

In the exercise of its rights and responsibilities under the agreements to which it is a party, the **Office of Scientific and Technical Information** both receives information from the above sources and submits U.S.-produced information to them. In addition to materials generated by the Department of Energy, this U.S.-produced information is gathered from other government agencies as well as under contract with private information processing companies. All input is computer processed and entered into a database for online retrieval. The database serves as well for the production of numerous OSTI publications.

How To Read A Citation

The coverage of literature in this publication includes several document types, ranging from technical reports to journal articles to books. The principal data elements included in these citations are:

1. **Abstract number** within volume.
2. **Report number** identification for report-type literature.
3. **Title and subtitle** (non-English title may appear in parentheses, if applicable).
4. **Author(s).** First 10 names in the data record are printed, then "et al." is listed.
5. **Author affiliation.** Only first one is listed, in parentheses after author(s) to which it applies.
6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Patent assignee and number** for citations of patent documents or applications.
9. **Journal title, volume, and issue** for citations of journal articles.
10. **Date of publication.** If not known, a processing date is in brackets.
11. **Number of pages** or page range.
12. **Language** of document if non-English.
13. **Monograph title** if citation is an analytic (part, chapter, or paper) of a larger monograph.
14. **Publisher's name and location** for documents published by a corporate or commercial source.
15. **Sponsoring organization.**
16. **Contract or grant number.**
17. **Secondary identifying number;** may be a conference number.
18. **Conference title, location, and date,** if applicable.
19. **Order number.** The "DE" order number may be used for ordering from NTIS or OSTI, as appropriate. The "TI" prefix is valid only at OSTI.
20. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
21. **Drop note** or explanatory statement.
22. **Abstract.**
23. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. **Wisconsin** Univ., Madison (USA). **Dept. of Physics.** [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246. **Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.**

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

Journal Article

19055 A theoretical and experimental investigation of long-pulse, electron-beam-produced rare gas plasmas. Brake, M.L.; Repetti, T.E. (Energy Beam Interaction Lab. of the Dept. of Nuclear Engineering, Univ. of Michigan, Ann Arbor, MI (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 16(5): 581-589 (Oct 1988). (CONF-881020–: Symposium on radiation physics, Sao Paulo, Brazil, October 3, 1988).

Visible emission spectroscopy (380-650 nm) has been performed on intense, electron beam (1 kA, 300 ns, 300 kV) produced Ar, Kr,...

Patent

18045 Polarization of fast particle beams by collisional pumping. Stearns, J.W. To Dept. of Energy, Washington, DC. USA Patent 4,724,117. 9 Feb 1988. Filed date 19 Oct 1984. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for polarizing a fast beam of particles by collisional pumping, comprising the steps of generating a beam...

How To Order from the Availability Sources

TO OBTAIN A REPORT

Report literature, usually identified by an alphanumeric identifier at the beginning of a citation, is available from the sources listed in the citation (see example of element 20 on page iii). Often the sources are listed as abbreviations. Corresponding addresses are provided at right from which documents with these abbreviations may be ordered. When "OSTI" is given, **DOE and DOE contractors may order these documents from OSTI.** (However, check with your library or information organization which may require that orders go through them to OSTI.) The public should order from NTIS or from one of the other agencies listed in the citation. To expedite processing, an order form is provided in the back of this publication. NOTE: The order numbers provide quicker access for report ordering. Use the order number where possible.

GPO
Superintendent of Documents
Government Printing Office
Washington, DC 20402

GPO Dep.
Available for inspection or interlibrary loan at Government Printing Office regional depository libraries.

INIS
Available only in microfiche.
INIS Clearinghouse
International Atomic Energy Agency
P.O. Box 100, A-1400
Vienna, Austria

NTIS
U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

OSTI
U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

TO OBTAIN NON-REPORT LITERATURE

Non-report literature generally is available from the commercial publisher or corporation listed in the citation. These documents may also be available for loan from local libraries. First, check with the local library. Other sources of information are:

Journal articles *Chemical Abstracts Service Source Index (CASSI)* tells which libraries, both U.S. and foreign, contain a journal and the available years. *Ulrich's International Periodicals Directory* contains information on the journal and its publisher. For librarians, another source of information is On-Line Computer Library Center (OCLC), for interlibrary loans.

Books, conferences, and monographs The source for these publications is the publisher or the originating society, organization, or institution. DOE-supported conferences and individual papers reporting DOE-supported research may be available as reports from OSTI.

Foreign material The Linda Hall Library is an excellent source of foreign materials. For translations of foreign language material, contact the Library of Congress National Translation Center. For material difficult to locate, check with the British Library Document Supply Centre.

On-Line Computer Library Center
6565 Frantz Road
Dublin, OH 43107-0702
614-764-6000

Linda Hall Library
5109 Cherry Street
Kansas City, MO 64110
816-363-4600

Library of Congress
National Translation Center
Washington, D.C. 20540
202-707-0100

British Library Document Supply Centre
Boston Spa, Weatherby
West Yorkshire
LS23 7BQ
United Kingdom

How To Use the Indexes

Five indexes are provided for approaching the content of each issue of *Energy Research Abstracts*. Descriptions of entries in these indexes follow.

Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 15:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 15:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

HYDROGEN ISOTOPES
See also DEUTERIUM
HYDROGEN 4
TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 15:18686 (RA;SU;In Russian)

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
15:18494 DOE/ER/40438–T1
FG02-88ER60664 **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**
15:17641 DOE/ER/60664–1

Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

DOE/ER/40438–
T1 15:18494 NTIS, PC A03/MF A01 - OSTI E 1.99: DE89007246 MF-411

Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the database records.* The following list includes all of the 39 first-level and the 308 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

Numerical Listing of Categories

01 COAL, LIGNITE, AND PEAT
- 03 Preparation
- 04 Processing
- 05 Products and By-Products
- 06 Properties and Composition
- 08 Waste Management
- 09 Environmental Aspects
- 10 Reserves, Geology, and Exploration
- 20 Mining
- 30 Transport, Handling, and Storage
- 40 Combustion
- 50 Economic, Industrial, and Business Aspects
- 60 Health and Safety
- 70 Legislation and Regulations

02 PETROLEUM
- 02 Reserves, Geology, and Exploration
- 03 Drilling and Production
- 04 Processing
- 05 Products and By-Products
- 06 Health and Safety
- 07 Economic, Industrial, and Business Aspects
- 08 Waste Management
- 09 Environmental Aspects
- 10 Legislation and Regulations
- 20 Transport, Handling, and Storage
- 30 Properties and Composition
- 50 Combustion

03 NATURAL GAS
- 02 Reserves, Geology, and Exploration
- 03 Drilling, Production, and Processing
- 04 Products and By-Products
- 05 Health and Safety
- 06 Economic, Industrial, and Business Aspects
- 07 Waste Management
- 08 Environmental Aspects
- 10 Legislation and Regulations
- 20 Transport, Handling, and Storage
- 30 Properties and Composition
- 40 Combustion

04 OIL SHALES AND TAR SANDS
- 02 Reserves, Geology, and Exploration
- 03 Drilling, Fracturing, and Mining
- 04 Oil Production, Recovery, and Refining
- 05 Properties and Composition
- 06 Products and By-Products
- 07 Health and Safety
- 08 Economic, Industrial, and Business Aspects
- 09 Waste Management
- 10 Environmental Aspects
- 20 Legislation and Regulations
- 30 Transport, Handling, and Storage
- 40 Combustion

05 NUCLEAR FUELS
- 01 Reserves, Exploration, and Mining
- 04 Feed Processing
- 05 Uranium Enrichment
- 07 Fuels Production and Properties
- 08 Spent Fuels Reprocessing
- 09 Transport, Handling, and Storage
- 10 Economic, Industrial, and Business Aspects
- 20 Waste Management
- 30 Environmental Aspects
- 40 Health and Safety
- 50 Safeguards, Inspection, and Accountability
- 60 Legislation and Regulations

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY
- 01 Physical Isotope Separation
- 02 Radiation Sources
- 03 Isotopic Power Supplies
- 04 Economic, Industrial, and Business Aspects
- 05 Health and Safety

08 HYDROGEN
- 01 Production
- 02 Storage, Transport, and Handling
- 04 Economic, Industrial, and Business Aspects
- 05 Health and Safety
- 07 Products and By-Products
- 08 Properties and Composition
- 09 Environmental Aspects
- 10 Waste Management
- 20 Legislation and Regulations
- 30 Combustion

09 BIOMASS FUELS
- 07 Resources
- 08 Production
- 09 Processing
- 10 Properties and Composition
- 20 Combustion
- 30 Economic, Industrial, and Business Aspects
- 40 Transport, Handling, and Storage
- 50 Environmental Aspects
- 60 Health and Safety
- 70 Legislation and Regulations
- 80 Waste Management
- 90 Products and By-Products

10 SYNTHETIC FUELS
- 02 Production
- 03 Properties and Composition
- 04 Combustion
- 05 Transport, Handling, and Storage
- 06 Health and Safety
- 07 Economic, Industrial, and Business Aspects
- 08 Waste Management
- 09 Environmental Aspects
- 10 Legislation and Regulations
- 20 Products and By-Products

13 HYDRO ENERGY
- 01 Resources and Availability
- 02 Site Geology and Meteorology
- 03 Plant Design and Operation

*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in DOE/TIC-4584, *Energy Data Base: Subject Categories and Scope*.

04 Legislation and Regulations
05 Economic, Industrial, and Business Aspects
06 Environmental Aspects
07 Power-Conversion Systems
08 Health and Safety

14 SOLAR ENERGY
01 Resources and Availability
03 Economic, Industrial, and Business Aspects
04 Environmental Aspects
05 Solar Energy Conversion
06 Photovoltaic Power Systems
07 Solar Thermal Power Systems
08 Ocean Energy Systems
09 Solar Thermal Utilization
10 Solar Collectors and Concentrators
20 Heat Storage
30 Health and Safety
40 Legislation and Regulations

15 GEOTHERMAL ENERGY
01 Resources and Availability
02 Geology and Hydrology of Geothermal Systems
03 Geothermal Exploration and Exploration Technology
04 Legislation and Regulations
05 Economic, Industrial, and Business Aspects
06 Environmental Aspects
07 Products and By-Products
08 Geothermal Power Plants
09 Geothermal Engineering
10 Direct Energy Utilization
20 Geothermal Data and Theory
30 Health and Safety
40 Waste Management

16 TIDAL AND WAVE POWER
01 Resources and Availability
03 Legislation and Regulations
04 Economic, Industrial, and Business Aspects
05 Environmental Aspects
07 Tidal Power Plants
08 Wave Energy Converters
09 Health and Safety

17 WIND ENERGY
01 Resources and Availability (Climatology)
03 Legislation and Regulations
04 Economic, Industrial, and Business Aspects
05 Environmental Aspects
06 Wind Energy Engineering
07 Health and Safety

20 FOSSIL-FUELED POWER PLANTS
01 Power Plants and Power Generation
02 Waste Management
04 Health and Safety
05 Environmental Aspects
06 Economic, Industrial, and Business Aspects
07 Legislation and Regulations

21 NUCLEAR POWER PLANTS
01 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled
02 Power Reactors, Nonbreeding, Light-Water Moderated, Nonboiling Water Cooled
03 Power Reactors, Nonbreeding, Graphite Moderated
04 Power Reactors, Nonbreeding, Otherwise Moderated or Unmoderated
05 Power Reactors, Breeding
06 Power Reactors, Auxiliary, Mobile, Package, and Transportable
07 Regulation and Licensing
08 Economics

22 NUCLEAR REACTOR TECHNOLOGY
01 Theory and Calculation
02 Components and Accessories
03 Fuel Elements
04 Control Systems
05 Environmental Aspects
06 Research, Test, and Experimental Reactors
07 Plutonium and Isotope Production Reactors
08 Propulsion Reactors
09 Reactor Safety

24 POWER TRANSMISSION AND DISTRIBUTION
01 Power Systems
02 Power System Networks, Transmission and Distribution
03 Power Transmission Lines and Cables
04 Health and Safety
05 Environmental Aspects
06 Legislation and Regulations
07 Economic, Industrial, and Business Aspects

25 ENERGY STORAGE
01 Magnetic
02 Compressed and Liquefied Gas
04 Capacitor Banks
05 Flywheels
06 Thermal
08 Chemical
09 Batteries
10 Economic, Industrial, and Business Aspects
20 Health and Safety
30 Environmental Aspects
40 Legislation and Regulations

29 ENERGY PLANNING AND POLICY
01 Energy Analysis and Modeling
02 Economics and Sociology
03 Environment, Health, and Safety
04 Energy Resources
05 Research, Development, Demonstration, and Commercialization
06 Nuclear Energy
07 Transport and Storage
08 Heat Utilization
10 Conservation
20 Supply, Demand, and Forecasting
30 Policy, Legislation, and Regulation
40 Fossil Fuels
50 Hydrogen and Synthetic Fuels
60 Electric Power
80 Consumption and Utilization
90 Unconventional Sources and Power Generation

30 DIRECT ENERGY CONVERSION
01 MHD Generators
02 EHD Generators
03 Thermoelectric Generators
04 Thermionic Converters
05 Fuel Cells
08 Miscellaneous Converters

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION
01 Buildings
02 Transportation
03 Industrial and Agricultural Processes
06 Municipalities and Community Systems
09 Education and Public Relations

33 ADVANCED PROPULSION SYSTEMS
01 Internal Combustion Engines
02 External Combustion Engines
03 Electric-Powered Systems
04 Hybrid Systems
05 Flywheel Propulsion
06 Vehicle Design Factors
07 Emission Control
08 Alternative Fuels

35 ARMS CONTROL
01 Policy, Negotiations, and Legislation
02 Proliferation
03 Verification

36 MATERIALS
01 Metals and Alloys

02 Ceramics, Cermets, and Refractories
06 Other Materials

40 CHEMISTRY
01 Analytical and Separations Chemistry
02 Inorganic, Organic, and Physical Chemistry
04 Electrochemistry
05 Photochemistry
06 Radiation Chemistry
07 Radiochemistry and Nuclear Chemistry
08 Combustion, Pyrolysis, and High-Temperature Chemistry

42 ENGINEERING
02 Facilities, Equipment, and Techniques
04 Heat Transfer and Fluid Flow
05 Materials Testing
10 Combustion Systems
20 Mining and Underground Engineering
30 Marine Engineering
50 Power Cycles
60 Components, Electron Devices and Circuits

43 PARTICLE ACCELERATORS
01 Design, Development, and Operation
02 Beam Dynamics, Field Calculations, and Ion Optics
03 Auxiliaries and Components
04 Storage Rings

44 INSTRUMENTATION
01 Radiation Instrumentation
02 Radiation Effects on Instrument Components, Instruments, or Electronic Systems
04 Well Logging Instrumentation
05 Thermal Instrumentation
06 Optical Instrumentation
07 Geophysical and Meteorological Instrumentation
08 Miscellaneous Instrumentation

45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE
01 Chemical Explosions and Explosives
02 Nuclear Explosions and Explosives
03 Nuclear Explosion Detection
04 Nuclear and Radiological Warfare
05 Strategic Defense Initiative
06 Chemical and Biological

54 ENVIRONMENTAL SCIENCES
01 Environmental Sciences, Atmospheric
02 Environmental Sciences, Terrestrial
03 Environmental Sciences, Aquatic

55 BIOMEDICAL SCIENCES, BASIC STUDIES
01 Behavioral Biology
02 Biochemistry
03 Cytology
04 Genetics
05 Metabolism
06 Medicine
07 Microbiology
08 Morphology
09 Pathology
10 Physiological Systems
20 Public Health
30 Agriculture and Food Technology

56 BIOMEDICAL SCIENCES, APPLIED STUDIES
01 Radiation Effects
02 Thermal Effects
03 Chemicals Metabolism and Toxicology
04 Other Environmental Pollutant Effects

57 HEALTH AND SAFETY

58 GEOSCIENCES

64 PHYSICS I
01 Astrophysics and Cosmology
02 Atmospheric Physics
03 Atomic, Molecular, and Chemical Physics
04 Fluid Physics
50 High Energy Physics
51 Particle Interactions and Properties—Experimental
52 Particle Interactions and Properties—Theoretical
53 Particle Invariance Principles and Symmetries
54 Field Theory

65 PHYSICS II
10 Nuclear Physics
11 Experimental Techniques
12-20 Nuclear Properties and Reactions
30 Nuclear Theory
40 Radiation and Shielding Physics
50 Medical Physics
60 Condensed Matter Physics
61 Superconductivity
70 Theoretical and Mathematical Physics

70 FUSION ENERGY
01 Plasma Research
02 Fusion Power Plant Technology

99 GENERAL AND MISCELLANEOUS
01 Management
02 Mathematics and Computers
03 Information Handling
04 Law

CORPORATE AUTHOR INDEX

PERSONAL AUTHOR INDEX

SUBJECT INDEX

CONTRACT NUMBER INDEX

REPORT NUMBER INDEX

ORDER NUMBER CORRELATION

Alphabetical Listing of Categories

33 ADVANCED PROPULSION SYSTEMS
35 ARMS CONTROL
09 BIOMASS FUELS
56 BIOMEDICAL SCIENCES, APPLIED STUDIES
55 BIOMEDICAL SCIENCES, BASIC STUDIES
40 CHEMISTRY
01 COAL, LIGNITE, AND PEAT
30 DIRECT ENERGY CONVERSION
32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION
29 ENERGY PLANNING AND POLICY
25 ENERGY STORAGE
42 ENGINEERING
54 ENVIRONMENTAL SCIENCES
20 FOSSIL-FUELED POWER PLANTS
70 FUSION ENERGY
99 GENERAL AND MISCELLANEOUS
58 GEOSCIENCES
15 GEOTHERMAL ENERGY
57 HEALTH AND SAFETY
13 HYDRO ENERGY
08 HYDROGEN
44 INSTRUMENTATION
07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY
36 MATERIALS
45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE
03 NATURAL GAS
05 NUCLEAR FUELS
21 NUCLEAR POWER PLANTS
22 NUCLEAR REACTOR TECHNOLOGY
04 OIL SHALES AND TAR SANDS
43 PARTICLE ACCELERATORS
02 PETROLEUM
64 PHYSICS I
65 PHYSICS II
24 POWER TRANSMISSION AND DISTRIBUTION
14 SOLAR ENERGY
10 SYNTHETIC FUELS
16 TIDAL AND WAVE POWER
17 W!ND ENERGY

Energy Research Abstracts

01 COAL, LIGNITE, AND PEAT

Refer also to citation(s) 37032

0103 Preparation

Refer also to citation(s) 36705

36689 (DOE/PC/72007–T14) **Ultra-fine coal characterization: Final report.** Smit, F.J.; Odekirk, J.R.; Baltich, L.K. AMAX Research and Development Center, Golden, CO (USA). Dec 1988. 215p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-84PC72007. Order Number DE90011936. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

The objectives of this Preparation Program include beneficiation of coal to produce high-quality solid or slurry fuel as alternatives for fuel oil and natural gas. Fine grinding is a necessary prerequisite if physical separations are being considered during such beneficiation since the impurity minerals are very fine-grained and dispersed throughout the coal mass. It is the purpose of this research to study the properties of ultra-fine coal since the behavior of such coal can be different from the behavior of the coarser coal normally encountered during cleaning. Research was divided into six tasks: (1) Sample Collection and Preparation: Suitable samples of the base case coal and eight other representative coals were collected and prepared for the subsequent test work. (2) Chemical and Bulk Property Determinations: Compositions, washabilities, moisture levels, and other coal properties which effect behavior of the fine coal in beneficiation systems were determined for each coal. (3) Mineral Liberation Studies: Liberation of the mineral matter in the coal achieved by fine and ultra-fine grinding and the degree of liberation was determined. (4) Hydrodynamic Study of Particles and Slurries: The deviation of individual fine coal particles from Stoke's Law free-settling behavior was determined. (5) Study of the Surface Properties of Particles: The surface characteristics of fine particles of coal which relate to the effectiveness of beneficiation processes were studied. These included electrical charges in aqueous media (zeta potential) and the wettability of the coals (contact angles), and (6) Predictive Model Development: Empirical predictive equations were developed relating measurable coal characteristics of ultra-fine coal to the response of the coal to froth flotation. Accomplishments are discussed in this report. 55 refs., 53 figs., 64 tabs.

0104 Processing

36690 (CONF-900546–9) **Moisture-induced embrittlement of Fe_3Al.** Alexander, D.J.; DeVan, J.H.; Sikka, V.K. Oak Ridge National Lab., TN (USA). [1990]. 5p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. From 4. conference on fossil energy materials; Oak Ridge, TN (USA); 15-17 May 1990. Order Number DE90012413. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Recent tests at ORNL indicate that the ductility of iron aluminides is very sensitive to the test environment. It is believed that the loss of ductility observed in moist air environments is associated with a hydrogen embrittlement phenomenon as a result of dissociation of water vapor and the intake of atomic hydrogen into the aluminide matrix. This possibility will be investigated in a series of tests under controlled environmental conditions. Compact specimens will be tested under controlled stress intensity conditions. Crack growth rates as a function of the applied stress intensity will be measured with the direct-current potential drop technique. Initial tests will be conducted in moist air and in vacuum at room temperature. In an additional series of tests the temperature of the moist air will be varied to permit the determination of an activation energy for the embrittlement process. Fractographic examination of the fracture surfaces will also be performed. It is anticipated that this series of test will increase our understanding of the environmentally-induced embrittlement of iron aluminide alloys. 2 refs., 1 fig.

36691 (CONF-900546–10) **Weldability of iron aluminides.** David, S.A.; Zacharia, T.; Reed, R.W. Oak Ridge National Lab., TN (USA). [1990]. 7p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. From 4. conference on fossil energy materials; Oak Ridge, TN (USA); 15-17 May 1990. Order Number DE90012722. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A preliminary investigation was carried out to determine the weldability of a class of advanced iron aluminides. Thin sheets of iron aluminides were gas tungsten arc (GTA) and electron beam (EB) welded at different travel speeds and power levels. The results indicate that the weldability of these alloys is very sensitive to the welding conditions and compositions, producing good welds sometimes and severely cracked welds at other times. Alloys containing TiB_2 additions for improved strength and ductility cracked severely upon welding. Alloys without boron and zirconium, in particular alloy FA-129, was found to show more promise for welding than most of the other iron aluminides. 4 refs., 3 figs., 2 tabs.

36692 (CONF-900546–11) **Development of surface treatments and alloy modifications for corrosion-resistant oxide scales.** DeVan, J.H. Oak Ridge National Lab., TN (USA). [1990]. 13p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. From 4. conference on fossil energy materials; Oak Ridge, TN (USA); 15-17 May 1990. Order Number DE90012723. Available from NTIS, PC A03/MF A01 - OSTI.

Alloys based on the long-range ordered system Fe_3Al are under development at Oak Ridge National Laboratory in support of coal conversion and combustion materials requirements. Of particular interest is the performance of these alloys in coal gasifiers involving product gases with relatively low oxygen activities and high sulfur activities. Using H_2S-H_2-H_2O gas mixtures, several experimental iron-aluminum alloys have been tested to assess the effects of aluminum concentration on oxidation-sulfidation response at 700 to 800°C in a simulated gasifier environment. Metallographic and chemical analyses of the corrosion product scales and the underlying alloy were performed to determine the role of respective metallic elements on the sulfidation-oxidation processes. These results, together with thermogravimetric analyses, are discussed in terms of the apparent corrosion mechanisms and optimization of alloy composition for exposure to coal-derived environments. More recently, the corrosion performance of an Fe-28% Al-2% Cr alloy has been evaluated in gases produced by an operating gasifier. The reaction products and scale morphologies under actual service conditions were generally similar to the laboratory test results except for the presence of an ash deposit on the gasifier specimens. 2 refs., 7 figs., 4 tabs.

36693 (DOE/MC/23283–2802) **Experimental and theoretical investigation of the formation and growth of ash agglomerates: Final report.** Carty, R.H.; Mason, D.M.; Kline, S.; Babu, S.; Arastoopour, H.; Hariri, H. Institute of Gas Technology, Chicago, IL (USA). Sep 1989. 127p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-87MC23283. Order Number DE90000455. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

This research program on the experimental and theoretical investigation of the formation and growth of ash agglomerates consists of 3 tasks: (1) facility preparation, (2) test program, and (3) test data analysis and interpretation. The result is a description of ash agglomeration as a function of temperature, velocities, particle size, and viscosity of the molten agglomerates. Major objectives include: investigation of the effects on ash behavior of the addition of limestone as an in-bed sulfur-capture agent and of the recycling of the effluent stream containing SO_2 from the regeneration of a hot-gas cleanup system to a fluidized-bed gasifier; determination of the maximum viscosity of molten ash that allows ash agglomerate growth and experimental measurement of agglomerate growth as a function of temperature, viscosity, and chemical composition; exploration of the development of an optimum design basis and

operating procedure for fluidized-bed coal gasification processes based on the analysis of bench-scale experimental data; and development of mathematical relationships based on fundamentals of fluid mechanics, heat transfer, and the previously developed Institute of Gas Technology (IGT) description of the agglomeration phenomenon in a fluidized-bed coal gasification system. 18 refs., 60 figs., 48 tabs.

36694 (DOE/PC/80538–T1) **Microbial liquefaction of peat for the production of synthetic fuels: Final progress report.** Gunasekaran, M. Fisk Univ., Nashville, TN (USA). Dept. of Biology. [1988]. 15p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-85PC80538. Order Number DE90012251. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Objectives of this study were: to evaluate the potential of using various microorganisms to hydrolyse and liquify peat; to determine the optimal conditions for peat hydrolysis and liquefaction; to study the co-metabolizable substances; to separate the compounds present in liquified peat by alumina and silica acid chromatography and capillary gas chromatography; and to identify the compounds in liquified peat by capillary GC-Mass spectrometry. Organisms used in the study include: Coprinus cornatus, Coriolus hirsutus, Ganoderma lucidum, Lentinus edodes, Lenzites trabea, Phanerochaete chrysosporium, Pleurotus ostreatus, P. sapidus, Polyporus adjustus, Neurospora sitophila, Rhizophus arrhizus, Bacillus subtilis, Acinetobacter sp. and Alcaligenes sp. The fungi were maintained and cultivated in potato dextrose agar at 30 C. The bacteria were maintained in nutrient agar at 30 C. We have also initiated work on coal solubilization in addition to the studies on peat liquefaction. A relatively new substratum or semi-solid base for culture media called Pluronic F-127, or Polyol (BASF, New Jersey). Objectives of this study were: (1) to study the growth patterns of Candida ML 13 on pluronic as substratum; (2) to determine the rate of microbial coal solubilization on pluronic F-127 amended in different growth media; (3) to separate the mycelial mat of Candida ML 13 from unsolubilized coal particles and solubilized coal products from pluronic F-127; (4) to determine the effects of pH on microbial coal solubilization in pluronic F-127 media; (5) the effect of concentration of pluronic F-127 in media on coal solubilization; and, (6) to study the role of extracellular factors secreted by Candida ML 13 on coal solubilization in pluronic F-127 media. Results are discussed. 4 refs.

36695 (DOE/PC/88922–6) **Supercritical fluid thermodynamics for coal processing: Quarterly progress report, January 1, 1990–March 31, 1990.** Eckert, C.A. Georgia Inst. of Tech., Atlanta, GA (USA). School of Chemical Engineering. [1990]. 8p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88922. Order Number DE90011073. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Because of their unusual solvating and mass transfer properties, supercritical fluids show potential for a variety of coal processing applications. We have established a database of coal model compound equilibria; to add to this database, we have developed and will be testing a method of rapidly measuring entrainer effects on solubility. In addition, we have used fluorescence spectroscopy to study the nature of the intermolecular interactions in the system of pyrene in supercritical fluoroform. The solubility and spectroscopic measurements are being used to guide the development of an equation of state that includes both physical and chemical interactions. The equation of state will be used to predict solubility behavior so systems can be designed for the processing of coal with supercritical fluids. 3 figs.

36696 (DOE/PC/89771–1) **Mechanism of hydrodenitrogenation: Part 1, Preparation and characterization of acidic supports.** Miranda, R. Louisville Univ., KY (USA). Dept. of Chemical Engineering. 25 Mar 1990. 14p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-89PC89771. Order Number DE90011445. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Hydrocarbon feedstocks for energy production are currently obtained mainly from heavy petroleum crudes. To a lesser extent today, but of greater importance in the future, are fuels obtained from coal liquids, shale oils and tar sand oils. A common denominator to all of these feedstocks is the high content of S-(primarily in petroleums), N-(primarily in coal liquids and heavy oils) and O-heterocyclic aromatics. Those heteroaromatics must be decomposed, and S, N and O compounds must be removed from feedstocks for various reasons: they poison the reforming catalysts used in refineries, they induce polymerization of unsaturated compounds and form gums during combustion, they produce corroders in combustion engines, and they form environmental pollutants. Thus major effort has been allocated to the development of catalysts that selectively desulfurize, denitrogenate and deoxygenate fuel feedstocks. A method was developed to prepare silica, r-alumina, and amorphous silica-aluminas of compositions varying from 10% wt % silica to 90 wt % silica. All samples were highly homogeneous, were produced in high yield, and were dense enough for further use as a catalyst support material. The materials were characterized as per their BET surface area, total acidity, acidity strength distribution and type of acidity. The uniform preparation technique allowed the production of a set of silica-aluminas with smoothly varying acidity as a function of composition. 2 refs., 7 figs., 2 tabs.

36697 (DOE/PC/89867–T1) **Slurry reactor design studies: Topical report, Reactor selection criteria.** Fox, J.M.; Degen, B.D. Bechtel Group, Inc., San Francisco, CA (USA). Apr 1990. 140p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-89PC89867. Order Number DE90010924. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report presents a discussion on design of slurry reactors applicable to several processes. Emphasis is placed on the Fischer-Tropsch process of which there is a literature review. (CBS)

36698 (FRNC-TH–3573) **Contribution to the study of low temperature pyrolysis of Gardanne coal.** Bertho, C. Poitiers Univ., 86 (France). 1987. 162p. (In French). Order Number DE90501053. Available from NTIS (US Sales Only), PC A08/MF A01.

The aim of this thesis is the study of the influence of experimental parameters (grain size, sample mass, inorganic matter, hydrogen, heating rate) on gas flow rate on coal from Gardanne (South of France) selected for high content in volatile matter. In complement solid evolution is followed by thermal gravimetric analysis and NMR. Condensable part of volatile matter (water, tar) is pyrolysed again in a two-step reactor and interaction between semi-coke (final product of pyrolysis) and volatile matter is investigated. 95 refs.

36699 (IS-T–1404) **Fundamental studies of supported ruthenium catalysts: Model reaction studies and NMR [nuclear magnetic resonance] of adsorbed molecules.** Kelzenberg, J.C. Ames Lab., IA (USA). Feb 1990. 119p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90011812. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Supported bimetallic cluster catalysts provide useful systems for fundamental catalytic investigations. The term 'bimetallic cluster' applies to systems composed of two metals that do not form bulk alloys. The aim of the work presented was to examine a series of silica supported bimetallic catalysts using reactor studies and to then extend the work to include nuclear magnetic resonance (NMR) studies. With NMR we probed the chemical and structural properties of adsorbed species and decomposition products at pressures much higher than possible in ultrahigh vacuum experiments.

36700 (MISC–90050) **Center for Bioprocessing Technology and Biotechnology.** EG and G Idaho, Inc., Idaho Falls, ID (USA). Mar 1990. 29p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE90012963. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Idaho National Engineering Laboratory (INEL) Research Center located in Idaho Falls is a focal point for a basic research in biotechnology, chemical sciences, environmental and earth sciences, material sciences, physics and electronic engineering. The Site is a center for basic nuclear physics and radiochemistry research, nuclear reactor safety research, defense programs, nuclear waste technology, and development of advanced energy concepts. Established in 1949, the INEL contains the largest concentration of nuclear reactors in the world. Current general research activities include work on nuclear fission energy, nuclear fusion energy,

geothermal energy, low-head hydropower, industrial energy conservation, and basic energy sciences. This paper discusses the current research objectives and projects at INEL. 1 fig.

36701 (MISC–90084) **Bioprocessing of fossil fuels program: Summary of advanced research and technology development sponsored activities for the period October 1, 1989–December 31, 1989.** EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 9p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC07-76ID01570. Order Number DE90012958. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Research on bioprocessing of coal is presented. Work is described in the following areas: biodesulfurization; thermophilic bacteria for biodesulfurization and ash removal; bioconversion to hydrocarbons and alcohols; molecular genetics of biodesulfurization; and bioprocess engineering. (CBS)

36702 (SAND–89-7088) **Chemical and biodesulfurization systems for removal of organic sulfur from coal: A critical review.** Gray, D. (Mitre Corp., McLean, VA (USA)); Sawy, A.E. Sandia National Labs., Albuquerque, NM (USA). May 1990. 162p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC04-76DP00789. Order Number DE90011259. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This study evaluates approaches being investigated for the chemical and biological removal of organic sulfur from coal. The chemical cleaning approaches include molten caustic leaching, solvent extraction, and other chemical interactions. The current state-of-the-art approaches result in considerable disruption of the coal structure and are potentially too costly to compete with flue gas desulfurization. The biological approaches evaluated include the DOE-supported programs for microbial removal of organic sulfur from coal at ARCTECH, Southern Illinois University, and the Institute of Gas Technology. Research in this area is still at an early stage, and a number of uncertainties concerning surface accessibility of organic sulfur in coal, verification of true percentage of organic sulfur in coal by direct measurement, and scale-up considerations have yet to be resolved before any coal biodesulfurization technique becomes a realistic option. 44 refs., 21 figs., 39 tabs.

0106 Properties and Composition

36703 (DOE/PC/79914–T11) **Macromolecular coal structure as revealed by novel diffusion tests: Quarterly technical report, January 15, 1990–April 15, 1990.** Peppas, N.A. Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering. [1990]. 88p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87PC79914. Order Number DE90011452. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Diffusion into coals is of considerable technological importance since many coal modification processes, such as direct liquefaction, desulfurization, demineralization, and chemical modification, involve diffusion of liquids or gases into the coal. The rate of reactants diffusing into the particles is often the rate-limiting step. Two different dynamic swelling studies were performed to elucidate the phenomenological and mechanistic analyses of swelling. The first method is the dynamic swelling desiccator studies which consist of high penetrant activity vapor swelling studies. The second method is the thermogravimetric analyzer studies which consists of low penetrant activity vapor swelling studies. The penetrant activity for chloroform, pyridine, and N,N-dimethylformamide were investigated. 8 refs., 34 figs., 11 tabs.

36704 (DOE/PC/88941–T6) **A study of coal particle shape and three-body wear: Quarterly report, January 1990–March 1990.** Clark, N.N.; Means, K.H. West Virginia Univ., Morgantown, WV (USA). Dept. of Mechanical and Aerospace Engineering. [1990]. 19p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88941. Order Number DE90011082. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Research on coal particle shape and wear continued. Testing with the three-body wear test machine is well underway. Two radically different particle shapes (utilizing aluminium oxide particles) are being used to compare the effects of shape on wear rates. Shape analysis is also underway on smaller particles. Changes made in the vision system will allow the complete particle to be analyzed for shape factors. A detailed description of work accomplished is given in the following sections. 2 refs., 3 figs., 1 tab.

36705 (DOE/PC/90507–T13) **Surface properties of coal and their role in coal beneficiation: Final report.** Fuerstenau, D.W.; Diao, J. California Univ., Berkeley, CA (USA). Coll. of Engineering. Mar 1990. 168p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90507. Order Number DE90012250. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

Understanding of the surface properties of coal and associated mineral matter is essential in order to remove sulfur-bearing and other ash minerals from finely ground coal using surface-based processes such as froth flotation and oil agglomeration. This investigation was conducted to identify and characterize those properties of coal that determine its wetting characteristics and its behavior in surface-based coal cleaning processes. Emphasis has been given to the surface oxidation of coal and its role in wetting behavior and the flotation response of coal. 203 refs., 71 figs., 13 tabs.

0108 Waste Management

Refer also to citation(s) 36889, 36892, 36893, 36894, 36895, 36896, 36897, 36898, 36899, 36900

36706 (CONF-900802–1) **Enhanced flue gas denitrification using ferrous EDTA and a polyphenolic compound having combined antioxidant and reducing properties.** Mendelsohn, M.H.; Harkness, J.B.L. Argonne National Lab., IL (USA). [1990]. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. From 200. American Chemical Society national meeting; Washington, DC (USA); 26-31 Aug 1990. Order Number DE90010101. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Previous work in this laboratory has involved studying the possibility of combined NO_x/SO_x scrubbing using various aqueous chemistries with a metal chelate additive. Recently, we have focused our work on the metal chelate ferrous*EDTA. A major problem encountered in the practical application of ferrous*EDTA is that the ferrous ion has been found to oxidize to the corresponding ferric species leading to a decrease of the NO_x removal for the scrubbing solution containing the additive. We have found that addition of a polyphenolic compound leads to a sustained high NO_x removal under various oxidizing conditions. We believe that the improved performance of ferrous*EDTA is due to the known capabilities of these organic compounds to both inhibit oxidation of ferrous chelates by dissolved oxygen and to rapidly reduce any ferric ions back to the original ferrous species. 5 refs., 7 figs.

36707 (CONF-900858–1) **Use of ferrous chelates for NO_x control in aqueous scrubbers.** Livengood, C.D.; Harkness, J.B.L.; Mendelsohn, M.H. Argonne National Lab., IL (USA). [1990]. 9p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. From Coal utilization and environmental control contractors review; Pittsburgh, PA (USA); 6-9 Aug 1990. Order Number DE90011172. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Argonne National Laboratory has been conducting research on combined NO_x/SO_2 control systems for the US Department of Energy since 1981. Recently, the research program has been focused on aqueous scrubber systems and has involved studies on NO_x removal through chemical additives based on Argonne's patented ARGONOX additives. Tests have been conducted in laboratory-scale aqueous scrubbers of two types. The experimental conditions were selected to simulate scrubbing of high-sulfur coal effluent gases. This paper describes recently performed experiments with the primary additive ferrous-EDTA with an organic secondary additive and two parametric test series with the additives ferrous-EDTA (having an iron to EDTA ratio of 1:1.2) and ferrous-cysteine (having an iron to cysteine ratio of 1:6) in a sodium carbonate chemistry. Two independent series of statistically designed experiments have been performed for the additives ferrous-1.2EDTA and ferrous-6cysteine in a sodium carbonate chemistry. The three variables selected for these studies were additive concentration, sulfur dioxide content in the feed gas stream, and oxygen concentration

in the feed gas stream. These tests enable one to compare different additives under identical conditions. 5 refs., 7 figs.

36708 (DOE/PC/91025–T2) **An investigation to define the physical/chemical constraints which limit NO_x emission reduction achievable by reburning: Final report.** Chen, S.L.; Ho, L.; Cole, J.A.; Seeker, W.R. Energy and Environmental Research Corp., Irvine, CA (USA). Oct 1989. 144p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-86PC91025. Order Number DE90011457. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report descries the efforts performed on a program designed to investigate the constraints of the reburning process for advanced NO_x control. The status and history of reburning technology will be reviewed first. This will be followed by descriptions of the program scope, the experimental approach, the experimental results, and the conclusions. Finally, the kinetic mechanisms of reburning will be presented as appendix. 20 refs., 62 figs., 2 tabs.

0109 Environmental Aspects

Refer also to citation(s) 37590

36709 (CONF-900801–5) **A comparison of direct control and market based policies for controlling emissions.** Fox, J.A.; Hanson, D.A. Argonne National Lab., IL (USA). [1990]. 4p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. From 25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990. Order Number DE90011113. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Emission control can be achieved by employing direct control policies such as performance standards and technology standards or by employing market based policies such as emissions trading, emissions taxes and marketable permits. This paper describes these policies and discusses the economic, social and political advantages and disadvantages of each type of policy. As the paper will show the chief disadvantage of the direct control policies is that they do not minimize the cost of obtaining the desired level of emissions in either the short or long run. One advantage of these policies is that they may be easier to administer then the market based plans. The chief advantage of the market based policies is that they are more likely to attain a desired emissions level at least cost in both a static and dynamic sense. These market based plans do have some shortcomings which are largely political in nature. For example, some people perceive these plans as "licenses to pollute" where wealthy firms can continue polluting by simply paying a tax, buying a permit or trading. 7 refs.

36710 Global energy and the greenhouse issue. Scott, M. (Battelle Pacific Northwest Laboratory, Richland, WA (USA)); Edmonds, J.; Kellogg, M.; Schultz, R. *Energy and Environment (UK)*, 1(1): 74-91 (1990).

Global energy production and use results in the release of CO_2 and other gases to the atmosphere which affect the atmosphere's radiative character. The accumulation of CO_2 and other radiatively important gases (RIGs) is thought to result in higher mean global surface temperatures and other climatic changes, whose character would vary regionally around the globe. Of critical importance to determining the timing and magnitude of global climate change is an understanding of long term global energy systems. Trace gases including methane (CH_4) nitrous oxide (N_2O), trichlorofluoromethane ($CFCl_3$ or CFC-11) and dichloro-difluoromethane (CF_2Cl_2 or CFC-12); carbon monoxide (CO) and other oxides of nitrogen (NO_x) have in recent years been included in considerations of the greenhouse issue with the result that the time when a greenhouse effect could be anticipated has been advanced. The interrelationship of land-use patterns and energy (especially the link between land use patterns and the harvesting and burning of traditional biomass fuels) is now increasingly being recognised and models extended to produce time-dependent scenarios of the effects of energy production, transformation and end-use on climate. The shift in research has opened up a new era of uncertainty. Interest in options to alter the rate of growth of greenhouse gas emissions has intensified, particularly since the 1988 Toronto climate Conference. Substantial work is underway to build on earlier efforts in this field. This paper documents the current understanding of the relationship between human activities, energy, CO_2 and other RIGs, surveys the global greenhouse forecast literature, and gives some assessment of forecasts uncertainty. 12 refs., 3 tabs.

0130 Transport, Handling, and Storage

Refer also to citation(s) 37386

36711 (DOE/PC/88949–T6) **Advanced study in solid transport: Rheological behavior of dense suspension: Sixth quarterly report, January 1, 1990–March 31, 1990.** Kim, H.J. (Pittsburgh Univ., PA (USA)); Chen, J.L.S.; Roidt, R.M.; Burgman, H.A. Westinghouse Electric Corp., Pittsburgh, PA (USA). Science and Technology Center. 27 Mar 1990. 44p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88949. Order Number DE90011142. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Experimental parameters have been estimated statistically. Water saturation is an important parameter, while rotational speed and shearing zone height are not significant. A phenomenological model is proposed by considering the effects of the friction force and the liquid bridge force, and by neglecting other forces. Shear stress is decomposed into frictional shear stress and capillary shear stress. Constants in the model are obtained from experiments and the regression analysis. Wall friction has measured for both static and dynamic cases. Contrary to dynamic intergranular shear stress measurements, the results show little difference between static and dynamic wall friction stress. During the next quarter experiments will be performed with coal and model development will continue. 10 refs., 5 figs., 7 tabs.

0140 Combustion

Refer also to citation(s) 36717, 36888

36712 (DOE/METC–90-4097) **Three-dimensional capacitance imaging system.** Fasching, G.E.; Smith, N.S. USDOE Morgantown Energy Technology Center, WV (USA). Apr 1990. 56p. Sponsored by U.S. DOE Fossil Energy. Order Number DE90000470. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The US Department of Energy's Morgantown Energy Technology Center (METC) has been developing a capacitance imaging system (CIS). This system measures the density distribution of a cold fluidized bed, displays a three-dimensional map in real time, and stores the data that it used to derive the map. This report describes the system, which uses four levels of two-dimensional density cross sections. It updates density data 100 times per second and displays 30 maps per second at each level. 14 refs., 30 figs., 2 tabs.

36713 (DOE/PC/89769–T1) **Predictive models for circulating fluidized bed combustors: Three dimensional code: Second technical progress report.** Gidaspow, D. Illinois Inst. of Tech., Chicago, IL (USA). Dept. of Chemical Engineering. Mar 1990. 67p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-89PC89769. Order Number DE90010842. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The overall objective of this investigation is to develop experimentally verified models for circulating fluidized bed (CFB) combustors. The Appendix to this report presents our three dimensional computer code which we developed in last few months. It generalizes the two dimensional version of our code FLUFIX used at Argonne National Laboratory. We tested this code by comparing the computations to a three-dimensional effect observed in bubbling fluidized beds. It is known that a circular jet entering a two dimensional bed produces maxima in time averaged porosities that are above the jet entrance, while two dimensional slit jets give maxima at the entrance. We found that our code is able to predict this three dimensional effect. There is, however, a small discrepancy between the computation and the experiment. This may due to the use of insufficiently fine grids, as seen by the poor resolution of bubbles. The computations were done on the University of

Illinois Cray X-MP, in corperation with the National Science Foundation. 3 refs., 11 figs.

36714 Modeling and measurements in coal-water slurry combustion for direct-fired gas turbine applications. Razdan, M.K. (General Motors Corp., Indianapolis, IN (USA). Allison Gas Turbine Div.); Wilkes, C. pp. 239 of Proceedings of the 9th Miami international congress on energy and environment. Volume 1-2 (Abstracts). Veziroglu, T.N. Univ. of Miami, College of Engineering, Coral Gables, FL (USA) (1989). (CONF-891210–: 9. Miami international congress on energy and environment, Miami Beach, FL (USA), 11-13 Dec 1989).

The authors are presently developing a direct-fired coal-fueled gas turbine engine primarily for industrial applications. The overall goal of the project is to develop and demonstrate an advanced coal-fueled gas turbine in the 5000 + hp class. As a part of this goal, a combustion system is being developed to meet several requirements: should be capable of burning coal-water slurry (CWS) with combustion performance of nearly 100%, ash carry-over should be minimized to meet deposition, erosion and corrosion (DEC) constraints for the turbine blades, should meet environmental standard for NO, SO, Co, UHV and particulates, and should also meet the traditional performance goals including acceptable exit pattern factor and wide turndown capability. For the present system, emissions are controlled by the use of rich-quench-lean (RQL) staged combustion concept. The combustion system is being developed through bench-scale testing, computer modeling and design optimization, and full scale development.

36715 A large amplitude oscillating combustor. Morris, G.J. (U.S. Dept. of Energy, Morgantown Energy Technology Center, Morgantown, WV (US)); Welter, M.J.; Richards, G.A. pp. 75.1-75.4 of Chemical and physical processes in combustion. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-8910124–: 22. chemical and physical processes in combustion fall technical meeting, Albany, NY (USA), 30 Oct - 1 nov 1989).

Growing utilization of pulse combustion has prompted recent experimental and theoretical investigations of oscillating combustors. The motivation of this work has been to capitalize on the well-known benefits of pulse combustion for heat transfer devices such as residential heaters, commercial fryers, water heaters, etc. In many of these applications, pressure oscillations are limited to a fraction of the ambient pressure to avoid excessively noisy operation. Consequently, detailed studies of pulse combustion behavior have generally avoided large amplitude pressure oscillations. However, large amplitude oscillations hold promise for a number of practical applications. Successful coal-water slurry atomization has recently been reported through the use of a pulse combustor, and a current review suggests that a number of coal combustion processes can be enhanced through large amplitude sound waves originating from an oscillating combustor. The paper reports a novel combustor configuration which has produced pressure pulses in excess of 2.8 atmospheres without any mechanical valving. The lack of mechanical valves eliminates durability questions which might hinder long term operation in industrial environments.

36716 New ignition phenomenon in coal combustion. Solomon, P.R. (Advanced Fuel Research, Inc., East Hartford, CT (USA)); Chien, P.L.; Carangelo, R.M.; Serio, M.A.; Markham, J.R. *Combustion and Flame (USA)*, 79(2): 214-215 (Feb 1990).

A new ignition phenomenon has been observed during studies of coal combustion. The experiment, which was described in a recent publication, injects coal particles suspended in a room-temperature carrier gas as a jet into a flowing preheated air stream. The new phenomenon is shown. The particles of interest are at the edge of the cold particle stream and have first contact with the surrounding hot preheated gas stream. They ignite and appear to burn on the particle's surface, as indicated by the fact that the width of the luminosity is roughly that of the particle diameter. The particles become hotter with increasing distance.

0150 Economic, Industrial, and Business Aspects

Refer also to citation(s) 37008, 37034

36717 (CONF-900801–4) **International competitiveness of clean coal technologies.** Gillette, J.L.; Szpunar, C.B. Argonne National Lab., IL (USA). [1990]. 5p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. From 25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990. Order Number DE90011101. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Clean coal technologies are being demonstrated in research programs under both public and private sponsorship. Many of these technologies have potential international applications — including markets in developing countries. To scope these potential markets and to match the appropriate technologies with these markets, a detailed evaluation has been undertaken which focuses on six countries. This evaluation suggests that markets for these technologies do exist in the international arena and that the technologies can be cost competitive with conventional and traditional alternatives. The identified markets include both new plant construction and refurbishing of existing facilities, especially where there is a desire to decrease the current dependence on imported oil. Potential niches for these technologies are discussed along with the implications for the ongoing research and development activities. 3 refs., 1 tab.

36718 (DOE/EIA–0363(90)) **Annual prospects for world coal trade 1990.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 11 Jun 1990. 112p. Sponsored by U.S. DOE Management & Administration. Order Number DE90013084. Available from NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.

Section 205(a)(2) of the Department of Energy Organization Act (Public Law 95-91) requires the Administrator of the Energy Information Administration (EIA) to carry out a central, comprehensive, and unified energy data information program that will collect, evaluate, assemble, analyze, and disseminate data and information relevant to energy resources, reserves, production, demand, technology, and related economic and statistical information. To meet these responsibilities in the area of coal export analysis and to aid the reader in understanding the circumstances surrounding US coal exports, the EIA prepared this report. The international data in this report reflect material obtained from the Organization for Economic Cooperation and Development, the International Energy Agency, and foreign governments, and from presentations at international coal conferences and coal trade publications. As such, these data are not validated EIA data, but nonetheless provide historical and prospective information about the international coal market. 13 figs., 11 tabs.

0160 Health and Safety

Refer also to citation(s) 36689

0170 Legislation and Regulations

Refer also to citation(s) 36709

02 PETROLEUM

0202 Reserves, Geology, and Exploration

Refer also to citation(s) 37564

36719 (DGMK–386) **Application of the absorption of seismic waves in hydrocarbon exploration.** Burkhardt, H.; Schuett, R.; Moerig, R.; Engelhard, L.; Pruessmann, H.; Toennies, V.; Schopper, J.R.; Debschuetz, W.; Kulenkampff, J.; Meissner, R. Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Technische Univ. Berlin (Germany, F.R.). Inst. fuer Angewandte Geophysik, Petrologie und Lagerstaettenforschung; Technische Univ. Braunschweig (Germany, F.R.). Abt. fuer Angewandte Kern- und Neutronenphysik; Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Geophysik; Kiel Univ. (Germany, F.R.). Inst. fuer Geophysik. Feb 1990. 315p. Available from Copy held by UB/TIB Hannover.

The adsorption of seismic waves was the subject of a 10 year research effort of university institutes together with companies of the petroleum industry. Based upon a previous project (ASW I), the application of the absorption of seismic waves as method in HC-exploration was investigated in this second phase (ASW II). The scope consists of the following objectives: 1. methodical investigations of the absorption evaluation; testing of ten different methods in a series of experiments; 2. absorption evaluation out of field data; evaluation of VSP- and reflection profiles, implementation and test in a processing tool; 3. laboratory investigations aiming on the clarification of absorption mechanisms for the lithological interpretation of absorption data. With the results of this project the application of the absorption of seismic waves in HC-exploration has been thoroughly tested and succcessfully improved. (orig.).

36720 (SAND–89-1227C) **A model for transient natural convection in a vertical cylinder with sidewall heating.** Webb, S.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900803–2: 9. international heat transfer conference, Jerusalem (Israel), 26-31 Aug 1990). Order Number DE90006540. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A model is needed to predict the fluid velocities and temperature stratification in the crude oil in the more than 50 oil-filled Strategic Petroleum Reserve (SPR) caverns during long-term storage in order to understand processes such as fluid mixing and temperature stratification. A simple two-region model has been developed to predict the transient velocity and temperature distribution in a vertical cylinder with sidewall heating. The two regions are a boundary layer region along the vertical walls and a central core region in the middle. The boundary layer behavior is analyzed by the local similarity method which has been modified to conserve energy and to include turbulence and mixed convection effects. The central core region is broken up into a number of vertical control volumes. 16 refs., 5 figs.

36721 Geoporphyrin analysis using an ion trap mass spectrometer. Van Berkel, G.J. (Oak Ridge National Lab., TN (USA)); Glish, G.L.; McLuckey, S.A. *American Chemical Society, Division of Petroleum Chemistry, Preprints (USA),* 34(1): 184 (Mar 1989). DOE Contract AC05-84OR21400. (CONF-8904127–: Trace elements in petroleum geochemistry symposium, Dallas, TX (USA), 9-14 Apr 1989).

Data obtained using mass spectrometry has advanced the understanding of porphyrin geochemistry and has been used, for example, in the reconstruction of depositional environments, for determination of sample maturity, and in correlation studies. Work in their laboratory is aimed at developing new and better mass spectrometric techniques to facilitate these types of applications. The Ion Trap Mass Spectrometer (ITMS) has proven to be ideally studied for this work due to its high sensitivity, multiple ionization modes, and capability to perform MS/MS and MS^n (where $n > 2$) experiments. In this paper, the basic theory and operation of the ITMS will be overviewed. Electron ionization and several chemical ionization methods are evaluated for their use in determining porphyrin distributions. Combining ionization methods that minimize porphyrin fragmentation with MS/MS and MS^n analysis is shown to provide detailed structural information on porphyrins within complex mixtures. This added degree of structural information provides a detailed porphyrin fingerprint that might prove valuable in correlation studies.

36722 Derivative spectrophotometry of metalloporphyrins from shale. Freeman, D.H. (Univ. of Maryland, College Park (USA)). *American Chemical Society, Division of Petroleum Chemistry, Preprints (USA),* 34(1): 183 (Mar 1989). (CONF-8904127–: Trace elements in petroleum geochemistry symposium, Dallas, TX (USA), 9-14 Apr 1989).

This research is part of a continuing effort to develop improved methods for the isolation and characterization of geoporphyrins. This talk will report problems solved and progress being made toward the determination of geoporphyrins in shale extract. PC controlled diode array spectrophotometry will be discussed as it offers greatly improved speed. The analytical results show that improved precision and sensitivity are obtained by using derivative methods for data enhancement. Evidence for, and measures against interparticle heterogeneity were found. Fergusons criteria (1962) for extraction testing and for the merit of using macroporous adsorbents for liquid chromatography were verified.

0203 Drilling and Production

36723 (BNL–44684) **Prospects for thermophilic microorganisms in microbial enhanced oil recovery (MEOR).** Premuzic, E.T.; Lin, M.S. Brookhaven National Lab., Upton, NY (USA). May 1990. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-900541–1: International conference on microbial enhanced oil recovery (MEOR), Norman, OK (USA), 27 May - 1 jun 1990). Order Number DE90012409. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Studies in this laboratory have shown that certain species of thermophilic microorganisms may satisfy microbial enhanced oil recovery (MEOR) requirements. Several species of thermophilic microorganisms have been grown in the presence of varying concentrations of crude oils at different temperatures and pressures. Experimental evidence indicates that some thermophiles are viable over long periods of time (six months) at 70°C and 2000 psi in the presence of crude oils as the sole source of carbon. The interaction between selected thermophilic microorganisms occurs in some cases under aerobic and in others under anaerobic conditions. During the interactions there are pH changes due to production of acids. Crudes are also emulsified. The extent of emulsification is microbial-species dependent, and considerable variations have been observed when the same crude oil has been biotreated with different types of microorganisms under otherwise identical experimental conditions. The analysis of the emulsified fraction indicated that hydrocarbons in the C_{13}–C_{26} range were present in the emulsion. The biotreatment also caused changes in the composition of the organic sulfur fractions, as well as an overall decrease in the content of sulfur-containing compounds of the crude oils tested. Further, biotreatment caused significant qualitative and quantitative changes in low and high molecular weight fractions of test oils. The observed changes in different molecular weight fractions are also species dependent. Experimental data will be presented and their significance in terms of MEOR will be discussed. 22 refs., 14 figs., 3 tabs.

36724 (DOE/BC/14204–6) **Cyclic CO_2 injection for light oil recovery: Performance of a cost shared field test in Louisiana: [Sixth quarterly report], April–June 1990.** Bassiouni, Z.A. Louisiana State Univ., Baton Rouge, LA (USA). Dept. of Petroleum Engineering. [1990]. 10p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-89BC14204. Order Number DE90012749. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The ultimate objective of this research is to provide a base of knowledge on the CO_2 huff 'n' puff process for the enhanced recovery of Louisiana crude oil. Project goals include laboratory corefloods to investigate several parameters important to the process, and numerical simulation to interpret coreflood results. Additional activities include construction and analysis of a field test data base to facilitate target reservoir screening, and to identify sensitive operational parameters. The information from laboratory corefloods and data base evaluations will be used in the design and implementation of a Department of Energy sponsored field tests. The results of all laboratory and field evaluations will be made available to the industry through workshops, periodic reports, and meetings. 2 refs., 1 fig., 4 tabs.

36725 (IFP–36-927) **Propagation in an adsorbing porous medium of a mixture of anionic and non-ionic surfactants.** Beauvais, G. Paris-6 Univ., 75 (France); Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France). 1989. 238p. (In French). Order Number DE90501037. Available from NTIS (US Sales Only), PC A11/MF A01.

Four surfactants are used for the study: Two anionic surfactants: sodium alkylbenzene sulfonates (one of them gives liquid crystal solutions in suspension over its water solubility) and two non-ionic ethoxylated alkylphenols. Migration of such mixture is governed by adsorption chromatographic separation and porous material properties for dispersion. Adsorption isotherms are determined for each

pure surfactant. Adsorption of surfactant mixtures is higher. A model giving adsorption in function of total concentration of surfactants is developed.

36726 (NIPER–476) **National Institute for Petroleum and Energy Research monthly progress report for May 1990.** National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA). 26 Jun 1990. 49p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FC22-83FE60149. Order Number DE90012687. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Progress is reported from research at NIPER in the following areas: reservoir assessment and characterization; TORIS research support; development of improved microbial flooding methods; development of improved surfactant flooding methods; development of improved alkaline flooding methods; development of improved mobility-control methods; gas miscible displacement; development of methods to improve mobility control and sweep efficiency in gas flooding; three-phase relative permeability; thermal processes for light oil recovery; thermal processes for heavy oil recovery; imaging techniques applied to the study of fluids in porous media; development of analytical methodology for analysis of heavy crudes; thermochemistry and thermophysical properties of organic nitrogen- and diheteroatom-containing compounds; microbial-enhanced waterflooding field project; technical analysis for underground injection control; phase 1 – reservoir data base development; EOR incentive projects survey; and feasibility study of heavy oil recovery in the Midcontinent Region (Oklahoma, Kansas, Missouri).

36727 (OPI–28, pp. 1-20) **Cathodic protection evaluation of well casings using wireline techniques.** Dennis, B. (Schlumberger of Canada, Calgary, AB (Canada)); Wood, G. Ontario Petroleum Inst., Inc., Chatham, ON (Canada). 1989. (CONF-8910417–: 28. annual conference of the Ontario Petroleum Institute, London (Canada), 15-17 Oct 1989; CE–03009). In *Twenty-eighth annual conference [of the] Ontario Petroleum Institute Inc.* Available from Ontario Petroleum Institute Inc, 70 Talbot Rd S, PO Box 340, Lambeth, ON, CAN N0L 1S0. Prices: PRICES UPON REQUEST.

Cathodic protection systems are becoming the only realistic solution to most field corrosion problems. The design of protection systems for well casings is described. The effectiveness of a casing cathodic protection scheme depends on such factors as anode geometry, formation resistivity, cement quality and interference from offsetting protection schemes. Cathodic protection can be monitored by a variety of measurements, but in situ potential profiling is the most valuable and is least susceptible to interpretation error. Schlumberger's CPET (Cathodic Protection Evaluation Tool) provides accurate casing potential measurements in both conductive and non-conductive fluids as well as air. A wellsite evaluation utilizes Ohm's law and the in situ measurements of casing resistance and potential difference every 2 ft. to determine axial current, current density and corrosion rate in mm/yr. Cathodic protection evaluation with older wireline techniques, and examples are discused. 6 refs., 12 figs.

0204 Processing

Refer also to citation(s) 36696, 36736

36728 (FRNC-TH–3566) **Study of the destruction of coke and of its precursors in presence of hydrogen on platinum base catalysts.** Peyrovi, M.H. Poitiers Univ., 86 (France). 1987. 123p. (In French). Order Number DE90501068. Available from NTIS (US Sales Only), PC A06/MF A01.

Coking of supported metal catalysts is a consequence of metal dehydrogenating activity giving diolefinic compounds which polymerize giving non-desorbing deposits. However these precursors can be destroyed by the catalyst either by the acid function (cracking) either by the metal function (hydrogenolysis). Coking results from production and destruction of hydrocarbon residues. Decomposition under hydrogen, of coke deposited on a catalyst is studied. Beneficial effect of rhenium or iridium additions is observed, allowing lower temperature for coke methanation.

0205 Products and By-Products

36729 (PNL–7338) **Techniques for multivariate sample design.** Williamson, M.A. Pacific Northwest Lab., Richland, WA (USA). Apr 1990. 89p. Sponsored by U.S. DOE Energy Information Administration. DOE Contract AC06-76RL01830. Order Number DE90012675. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

In this report we consider sampling methods applicable to the multi-product Annual Fuel Oil and Kerosene Sales Report (Form EIA-821) Survey. For years prior to 1989, the purpose of the survey was to produce state-level estimates of total sales volumes for each of five target variabies: residential No. 2 distillate, other retail No. 2 distillate, wholesale No. 2 distillate, retail residual, and wholesale residual. For the year 1989, the other retail No. 2 distillate and wholesale No. 2 distillate variables were replaced by a new variable defined to be the maximum of the two. The strata for this variable were crossed with the strata for the residential No. 2 distillate variable, resulting in a single stratified No. 2 distillate variable. Estimation for 1989 focused on the single No. 2 distillate variable and the two residual variables. Sampling accuracy requirements for each product were specified in terms of the coefficients of variation (CVs) for the various estimates based on data taken from recent surveys. The target population for the Form EIA-821 survey includes companies that deliver or sell fuel oil or kerosene to end-users. The Petroleum Product Sales Identification Survey (Form EIA-863) data base and numerous state and commercial lists provide the basis of the sampling frame, which is updated as new data become available. In addition, company/state-level volumes for distillates fuel oil, residual fuel oil, and motor gasoline are added to aid the design and selection process. 30 refs., 50 figs., 10 tabs.

0206 Health and Safety

Refer also to citation(s) 36943

0207 Economic, Industrial, and Business Aspects

Refer also to citation(s) 36729, 37011, 37034

36730 (DOE/EIA–0109(90/03)) **Petroleum supply monthly, March 1990.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 25 May 1990. 127p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE90012686. Available from NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

Data presented in the Petroleum Supply Monthly (PSM) describe the supply and disposition of petroleum products in the United States and major US geographic regions. The data series describe production, imports and exports, inter-Petroleum Administration for Defense (PAD) District movements, and inventories by the primary suppliers of petroleum products in the United States (50 States and the District of Columbia). The reporting universe includes those petroleum sectors in "Primary Supply." Included are: petroleum refiners, motor gasoline blenders, operators of natural gas processing plants and fractionators, inter-PAD transporters, importers, and major inventory holders of petroleum products and crude oil. When aggregated, the data reported by these sectors approximately represent the consumption of petroleum products in the United States. Data presented in the PSM are divided into two sections (1) the Summary Statistics and (2) the Detailed Statistics. 12 figs., 46 tabs.

36731 (DOE/EIA–0520(90/02)) **International petroleum statistics report, February 1990.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 27 Feb 1990. 36p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE90012862. Available from NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

This report presents data on international oil production, consumption, imports, exports, and stocks. The report has three sections. Section 1 contains time series on world oil production, and oil consumption and stocks in the Organization for Economic Cooperation and Development (OECD). This section contains annual data beginning in 1973, and monthly data for the most recent

two years. Section 2 presents an oil supply/consumption balance for the market economies (i.e. non-communist countries). This balance is presented in quarterly intervals for the most recent data beginning in 1982, and quarterly data for the most recent two years. 23 tabs.

36732 (PB–90-928600/XAB) **International Energy Statistical Review. Monthly report.** Central Intelligence Agency, Washington, DC (USA). 1990. vp. Available from NTISSubscription.

Supersedes PB–89-928600. Paper copy available on subscription, North American Continent price $80.00/year; all others write for quote. Also available in single copies.

International Energy Statistical Review presents economic and statistical information on International oil production, oil consumption, oil imports and exports, crude oil production, natural gas production, storage imports, and exports. It also deals in the areas of oil and natural gas trade, oil stocks, oil spot market price, retail petroleum product prices, and crude oil prices. There are approximately 30 pages per monthly issue.

36733 Oil production in the United States. Reister, D.B. (Oak Ridge National Lab., Oak Ridge, TN (US)). pp. 130-140 of Energy economics and energy politics. International Assoc. of Energy Economists, Washington, DC (USA) (1987). DOE Contract AC05-84OR21400. (CONF-871122–: 9. annual North American meeting of the International Association of Energy Economists on energy economics and energy politics, Washington, DC (USA), 11-13 Nov 1987).

The authors have developed a preliminary version of RCIP. The model provides a successful backcast of the historical data on drilling footage. The model is less successful at backcasting oil discoveries, finding rate, and oil production. The oil price collapse in 1986 led to a collapse of drilling and concern about oil imports. Representatives of the oil producing states have suggested that the federal government should establish an oil import fee and provide domestic exploration incentives. The analysis reported in this paper suggests that large incentives would be required before drilling footage would return to the 1981 level.

36734 Petroleum industry restructuring: The influence of tax and antitrust policies. Coburn, L.L (U.S. Dept. of Energy (US)). pp. 141-152 of Energy economics and energy politics. International Assoc. of Energy Economists, Washington, DC (USA) (1987). (CONF-871122–: 9. annual North American meeting of the International Association of Energy Economists on energy economics and energy politics, Washington, DC (USA), 11-13 Nov 1987).

The motives for petroleum industry restructuring are many, including financial, economic, and managerial. While most observers of the recent petroleum industry acquisition wave focus ont he mismatch between market values and underlying asset values, reserve replacement economic efficiency, or even market speculation, many believe that tax incentives play a substantial role in driving or structuring these mergers and acquisitions. In addition, the shift in antitrust philosophy is viewed as creating a more lenient enforcement climate within which mergers and acquisitions occur. This paper focuses on these two government policies, tax and antitrust, to determine the extent, if any, these policies explicitly or implicitly provide motivation for mergers and acquisitions (M and As) and specifically petroleum industry M and As.

0208 Waste Management

Refer also to citation(s) 37149

0209 Environmental Aspects

Refer also to citation(s) 36742, 37149, 37564, 37605

0220 Transport, Handling, and Storage

36735 (PR–164-804) **The significance of local hard zones on the outside of pipeline girth welds: Final report.** Walker, R.A. Welding Inst., Cambridge (UK). ©Jul 1989. 57p. Sponsored by American Gas Association. Available from American Gas Association, 1515 Wilson Blvd., Arlington, VA 22209 $50.00.

In petrochemical and oil and gas production plant the presence of sour, H_2S containing environments poses problems with regard to material behaviour. A serious problem relating to sour environments is sulphide stress cracking (SSC), when the presence of hydrogen may lead to stress corrosion cracking in a susceptible material. In carbon-manganese steels, susceptibility to SSC is associated with a hardened microstructure and control of the problem therefore requires limitations on material hardness. This is especially important in welded structures where the rapid cooling associated with welding may lead to a hardened heat affected zone (HAZ), together with significant residual welding stress. To determine to what extent a relaxation in external hardnesses could be possible, The Welding Institute proposed a programme of work to study the influence of hardness and stress levels on the cracking propensity of GMA welds in pipeline steel. The project was to be carried out in two phases: in the first, three hardness limit for internal GMA bead on pipe welds (simulating weld root regions) was to be determined in a sour (NACE) solution; in Phase 2, external bead on pipe welds (simulating weld cap regions) would be assessed again with the sour environment on the inside of the pipe. The research proposal was accepted by the American Gas Association under Contract No PR-164-804. This report presents the results of both phases of the study.

0230 Properties and Composition

Refer also to citation(s) 36726, 36740

36736 (DGMK–402) **Short path molecular distillation and extraction with gases in the supercritical state for improved characterization of petroleum residues.** Severin, D. Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Institut fuer Erdoelforschung, Clausthal-Zellerfeld (Germany, F.R.). Dec 1989. 29p. (In German). Available from Copy held by UB/TIB Hannover.

This research project is concerned with the extraction of petroleum residues by gases in the supercritical state. An extraction unit was developed and the extracts obtained under different temperature and pressure conditions were compared with those obtained from a short path distillation unit in terms of various physical/chemical properties. (orig.) With 6 figs., 6 tabs., 31 refs.

36737 (DGMK–418-1) **Analytical methods for metals in petroleum and related products.** Kaegler, S.H. Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Deutsche Shell AG, Hamburg (Germany, F.R.). PAE-Lab. Jan 1990. 152p. (In German). Available from Copy held by UB/TIB Hannover.

The literature of analytical methods for metals in petroleum and related products is critically reviewed. Above all the metals V, Ni, Cd, As, Hg, Co, Cu, Mn and Sb are concerned. The methods are compared and listed according to their efficiency. (orig.) With 5 tabs., 472 refs.

36738 (FRNC-TH–3574) **Group contribution method for correlating and forecasting thermodynamic properties of petroleum fluids.** Wahabou, A. Aix-Marseille-3 Univ., 13 - Marseille (France). 1987. 274p. (In French). Order Number DE90501052. Available from NTIS (US Sales Only), PC A12/MF A01.

A group contribution method is presented for representating and forecasting thermodynamic properties of slightly polar fluids without molecular associations. The method combines the Peng-Robinson equation of state and an excess function model based on zero order approximation of Guggenheim quasi-reticular theory. At low pressure, the method gives liquid-vapor equilibria of hydrocarbon mixtures within a mean accuracy of about 1% and a fair restitution of thermal effects. For pressurized mixtures, hydrocarbon-hydrocarbon, hydrocarbon-supercritic fluid, higher accuracy is obtained in vapour-liquid equilibria by comparison with classical methods using binary interaction parameters especially for alkane-alkane systems type light-heavy.

36739 Comparison of isothermal and nonisothermal pyroyisis data with various rate mechanisms: Implications for

kerogen structure. Burnham, A.K. (Lawrence Livermore National Lab., CA (USA)); Braun, R.L.; Taylor, R.W.; Coburn, T.T. *American Chemical Society, Division of Petroleum Chemistry, Preprints (USA)*, 34(1): 36-42 (Mar 1989). DOE Contract W-7405-ENG-48. (CONF-8904125–: Comparative studies of various shale oils symposium, Dallas, TX (USA), 9-14 Apr 1989).

In order to derive chemical kinetic rate constants that can be extrapolated over a wide range of reaction conditions, it is usually necessary to fit the kinetic data to a model that accounts for important aspects of the reaction mechanism. Kerogen pyrolysis is an extremely complicated process, so it is impossible to consider individual reactions. Therefore, the goal is to construct a global reaction model in which important stages of reaction and classes of reactions are treated by a single rate expression. Two global reaction models that have been used frequently for kerogen pyrolysis are the multiple-parallel reaction model and the kerogen-to-bitumen-to-oil serial reaction model. While these models may be able to describe some aspects of kerogen pyrolysis, they give fundamentally different predictions for certain aspects of oil generation. The purpose of this paper is to examine kerogen pyrolysis under conditions where the differences between these models can be tested. They find that both models have significant weaknesses. They discuss the implications of their results for the structure of kerogens, and they attempt to derive more realistic global models that take these possible structures into account. One promising model is the alternate pathway model.

0250 Combustion

36740 The role of olefins in the autoignition chemistry of paraffinic hydrocarbons. Wilk, R.D. (Dept. of Mechanical Engineering, Union College, Schenetady, NY (US)); Cernansky, N.P. pp. 14.1-14.4 of Chemical and physical processes in combustion. Combustion Institute, Pittsburgh, PA (USA) (1989). Contract DAA629-85-K-0253. (CONF-8910124–: 22. chemical and physical processes in combustion fall technical meeting, Albany, NY (USA), 30 Oct - 1 nov 1989).

Olefins are found to be major intermediates in the preignition oxidation chemistry of paraffinic hydrocarbons. Most olefin compounds are fairly reactive and, once formed, can oxidize to form secondary products. Thus, olefin oxidation chemistry is inherently part of the oxidation chemistry of paraffins. Furthermore, olefinic compounds are important constituents of automotive fuels, making up approximately 10% of the composition of unleaded gasoline. This paper discusses how it is important to determine how these compounds behave in oxidative systems in order to understand how they influence certain combustion phenomena such as engine knock.

36741 Studies of thermodynamic non-ideality effects on chemical equilibrium and oxidation reactions in supercritical fluids. Bergan, N.E. (Sandia National Lab., Livermore, CA (US)); Melius, C.F.; Dwyer, H.A. pp. 23.1-23.4 of Chemical and physical processes in combustion. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-8910124–: 22. chemical and physical processes in combustion fall technical meeting, Albany, NY (USA), 30 Oct - 1 nov 1989).

Computer models incorporating real-gas equations of state and quantum chemical BAC-MP4 calculations are used to study the unique behavior of chemical equilibria and oxidation reactions in supercritical water. The authors focus on two issues. They quantify effects of thermodynamic non-idealities on chemical equilibria for typical combustion species and transition states in supercritical water. Using the BAC-MP4 method the authors identify alternate chemical reaction mechanisms that include water as an oxidation catalyst.

36742 Soot formation in fuel sprays. Parker, T.E. (Purdue Univ., West Lafayette, IN (US)); Morency, J.R.; Raulins, W.T. pp. 62.1-62.4 of Chemical and physical processes in combustion. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-8910124–: 22. chemical and physical processes in combustion fall technical meeting, Albany, NY (USA), 30 Oct - 1 nov 1989).

Soot is both a serious air pollutant and a major contributor to diesel engine wear. Typically, it is formed in fuel rich zones which are difficult to probe with conventional optical diagnostics due to optical thickness considerations. This paper reports on the development of a diagnostic technique which can be used to qualitatively identify soot formation zones within a fuel spray.

03 NATURAL GAS

0302 Reserves, Geology, and Exploration

Refer also to citation(s) 36719

36743 (RISO-M–2779) **Geochemical criteria for reservoir quality variations in chalk from the North Sea.** Kunzendorf, H.; Soerensen, P. Risoe National Lab., Roskilde (Denmark). Chemistry Dept. Dec 1989. 100p. Contract EM-1313/86-5. Order Number DE90631179. Available from NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

EFP-86.

The influence of chalk geochemistry on petrophysical parameters determining porosity and permeability is investigated. The central well TWB-8 and eastern marginal well E-lx of the North Sea Tyra gas field were chosen. Drill core sections of Upper Maastrichtian and Danian chalk were selected. Chemical data on chalk samples were gathered by using X-ray fluorescence and instrumental neutron activation. Geochemical data are compared with the well-logging results. Geophysical logging suggests that there is reduced porosity in the Danian reservoir units LDP and UDT in both wells. The chalk drill core samples from the section with reduced porosity also show a lower Ca content. A high Si content is observed in these samples and a number of trace elements in chalk show a similar distribution with depth. Reservoir porosity may be estimated from the Si content of chalk. Chalk permeability may also be elements Al, Fe and Sc show the same trends as that for Si. Diagenetic changes in chalk also include clay minerals. The gas zone in TWB-8 is characterized by low contents of Na and Cl, i.e. lower water saturation is indicated. Low concentrations of rare earths in all chalk samples show a shale-normalized pattern that is characteristic of marine sediments laid down under oxic conditions. Some changes that occur with depth in the Ce anomaly may indicate a slight change in the depositional environment. The content of manganese continuously decreases with depth, from Danian (about 2000 ppm) to Maastrichtian strata (less than 200 ppm). In this respect, no other chemical element in chalk correlates with Mn. There is no indication as to which mineral or mineral phase one is likely to find in the element. (AB) 14 tabs., 49 ills., 147 refs.

0303 Drilling, Production, and Processing

36744 (PR–15-633) **An investigation of amine-induced stress corrosion cracking of steels in natural gas treatment plants: Final report.** Southwest Research Inst., San Antonio, TX (USA). ©Oct 1989. 56p. Sponsored by American Gas Association. Available from American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209; $50.00.

This report describes a research program that was conducted by Southwest Research Institute (SwRI): to determine the factors responsible for stress corrosion cracking (SCC) of steels in natural gas treatment plants using ethanolamine solutions to remove acid gases from natural gases; and to determine modifications to plant equipment and/or process equipment that might be used to control SCC in natural gas treatment plants. The initial task of the program consisted of a review of available information regarding SCC in ethanolamine acid-gas removal systems. An extensive review of a National Association of Corrosion Engineers (NACE) survey and a review of the general technical literature in this area were conducted. Also, operating personnel in a number of natural gas treatment plants were contacted to determine experience and operating conditions. Subsequently, an experimental laboratory program consisting of electrochemical characterizations and slow-strain-rate SCC tests on steels was conducted. The majority of the laboratory test were performed using A 516 Grade 70 steel, a material that has been used widely in the construction of pressure vessels in natural gas treatment plants. Test were conducted in monoethanolamine (MEA) solutions and diethanolamine solutions

(DEA), the ethanolamines most widely used for acid gas removal in gas treatment plants. A more limited number of tests was conducted using A 515 Grade 70 steel, a material that was used in older plants and in which no instances of SCC have been reported. A few tests also were conducted on the A 516 material in solutions containing a widely-used general corrosion inhibitor. 16 refs., 21 figs., 12 tabs.

0304 Products and By-Products

Refer also to citation(s) 37350

0306 Economic, Industrial, and Business Aspects

Refer also to citation(s) 36732, 37008, 37034

36745 **Integration of the natural gas markets in Western Europe.** Hopper, R.J. (Federal Energy Regulatory Commission, Washington, DC (US)); Munkegaard, J.; Bungaard-Jorgensen, U. pp. 153-163 of Energy supply in the 1990s and beyond. International Assoc. of Energy Economists, Washington, DC (USA) (1989). (CONF-8906108--: 11. annual IAEE international conference on energy supply for the 1990's and beyond, Caracas (Venezuela), 26-28 Jun 1989).

this paper will assume that some form of open access is inevitable if the European Community (EC) is serious about developing a single unified energy market [and bringing] increased competitiveness and profitability by the end of 1992. This study introduces a framework and the tools necessary to implement open access in Europe. Open access programs in the U.S. and Canada are used for guidance.

0320 Transport, Handling, and Storage

Refer also to citation(s) 36735, 37194

36746 (NG–18-182) **The use of flattened specimens to measure the Charpy V-notch impact properties of thin-wall pipe.** Williams, D.N. Battelle, Columbus, OH (USA). ©Dec 1989. 47p. Sponsored by American Gas Association. Available from American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209 $50.00.

API Specification 5L, Supplemental Requirement SR5, 37th Edition, requires that Charpy V-notch (CVN) impact properties of pipe from which full size (0.394 x 0.394 inch) transverse specimens cannot be obtained, because of wall-thickness/pipe-diameter limitations, be measured with unflattened 2/3 size (0.263 x 0.394 inch) or 1/2-size (0.195 x 0.394) transverse specimens. Since the use of subsize specimens is known to introduce significant problems in measuring transition temperature interest has been expressed in the possibility of measuring CVN impact properties with flattened specimens to maximize specimen thickness, i.e., use full wall thickness, when subsize specimens are necessary. The present study was undertaken to examine the merit of this approach.

36747 (NG–18-183) **Ductile fracture properties of selected line-pipe steels.** Leis, B.N.; Brust, F.W. Battelle, Columbus, OH (USA). ©Jan 1990. 29p. Sponsored by American Gas Association. Available from American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209 $50.00.

This report is the first of a series of topical reports presenting the results of research to assess the effects of a hydrotest and repeated hydrotesting on flaw growth in line pipes. This report presents ductile fracture properties that are used in assessing stable flow growth in line pipes. These properties are presented following a brief discussion of the J-tearing theory that forms the basis for the analysis method that has been developed. The specific properties presented are the J-initiation resistance to cracking (J_{Ic}) and the J-tearing resistance to stable crack extension (T_R). Test methods to develop these properties are presented along with discussion of data analysis. Results are presented for three line-pipe steels for the LT (through-wall axial flaw) orientation, for three levels of prestrain. The results show a strong dependence of J_{Ic} on prestrain with initiation resistance decreasing as prestrain increases. Initiation resistance also was shown to increase with increasing flow stress, s_f. In contrast, tearing resistance was not uniquely dependent on flow stress and was independent of prior prestrain. 36 refs., 10 figs., 1 tab.

36748 (NG–18-184) **Investigation of sulfide-stress cracking at pipe seam welds.** Cialone, H.J. (Battelle, Columbus, OH (USA)); Williams, D.N. American Gas Association, Inc., Arlington, VA (USA); Battelle, Columbus, OH (USA). ©Aug 1989. 46p. Sponsored by American Gas Association. Order Number DE90012841. Available from American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209 $50.00.

A metallurgical investigation was undertaken to identify the factors that are responsible for sensitivity to sulfide-stress cracking (SSC) in the heat-affected zone (HAZ) of microalloyed high-strength line-pipe steels, when the HAZ does not contain regions of high hardness. Sustained-load tests were conducted in the NACE laboratory sour-gas environment to determine the regions in which SSC initiated, and thereby to identify which regions were most sensitive to SSC. In almost every steel studied in this task, SSC initiated in a specific region of the HAZ, usually in the region that was heated into the intercritical temperature range during welding. One steel exhibited SSC sensitivity in the region adjacent to the weld metal, which was heated above the upper critical temperature during welding, and another steel exhibited SSC sensitivity in the base metal following a laboratory normalizing heat treatment. In all of the steels that were studied, the region that exhibited sensitivity to SSC contained columbium carbonitride precipitates, 100 to 200 Angstroms in diameter, which were coarser than those that were present in the pipe body (<50 Angstroms in diameter) which was immune to SSC as fabricated except at very high stresses. Steels that did not contain columbium exhibited no sensitivity to SSC at applied stresses well above the specified minimum yield strength.

36749 (PR–3-805) **A modified criterion for evaluating the remaining strength of corroded pipe: Final report.** Kiefner, J.F.; Vieth, P.H. Battelle Columbus Div., OH (USA). ©22 Dec 1989. 126p. Sponsored by American Gas Association. Available from American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209 $100.00.

Includes 1 diskette.

Described herein is an improved method for evaluating the remaining strength of corroded pipe. The pipeline industry currently uses the "B31G" criterion to evaluate corroded pipe for removal or repair or for leaving it in service if the metal loss is within safe size limits as defined in the B31G criterion. A new and improved criterion was desired because of the known excess conservatism in the original B31G method. Even though the use of the B31G criterion has undoubtedly helped pipeline operators to avoid many unnecessary cut outs, the excess conservatism continues to cause some unnecessary cut outs that could be avoided without compromising safety. Thus, this project was undertaken to devise a modified criterion that, while still assuring adequate pipeline integrity, would eliminate as much as possible the excess conservatism embodied in the existing criterion. The proposed modified criterion presented herein is less conservative than the existing B31G criterion. It will permit metal-loss anomalies of greater size to remain in service at the current maximum operating pressure. And, for anomalies which exceed the newly recommended allowable size, the modified criterion will require less pressure reduction to maintain an adequate margin of safety for all cases in which the reduced pressure level exceeds 55 percent of SMYS.

36750 (PR–140-709) **Engineering critical assessment of girth welds in small diameter pipe: Final report.** Bala, S.R. Welding Inst. of Canada, Oakville, ON (Canada). ©Jun 1989. 102p. Sponsored by American Gas Association. Available from American Gas Association, 1515 Wilson Blvd., Arlington, VA 22209 $50.00.

Four girth welds containing hydrogen induced cracking (HIC) defects at the root were prepared in small diameter (305 mm) thin wall (6.35 mm) X52 pipes using E6010 (E41010) electrodes for the root and hot passes and E7010 (E48010) electrodes for the fill and capping passes. The CTOD tests were performed for the girth welds using each of HIC as well as fatigue precrack for the crack. The minimum, the average and an intermediate (between minimum and average) CTOD value at −40°C obtained for the specimens

containing HIC were used to determine the surface crack sizes for the girth weld roots from BS PD6493. The girth weld containing the 1/4 thickness HIC was full scale tested at −40°C. The test was terminated when the remote strain gauges showed plastic deformation/buckling in the pipe. The second and third full scale girth weld tests were carried out with the half wall and an intermediate (between 1/4 and 1/2 wall) wall defect. In both cases the girth failed when the remote strain gauge readings in the pipe were still elastic. Fracture surfaces of both the full scale tests showed ligament yielding and tear at the defect location. The fracture mode along the girth circumference was mixed: both ductile and brittle.

36751 (PR–185-815-Vol.1) **Review of procedures for welding onto pressurized pipelines: Final report: Volume 1.** Edison Welding Inst., Columbus, OH (USA). ©26 May 1989. 53p. Sponsored by American Gas Association. Available from American Gas Assoc., 1515 Wilson Blvd., Arlington, VA 22209 $25.00.

The welding of attachments into pressurized pipelines and storage vessels (referred to as hot tapping) is a necessary and common operation in the transmission industry. Care must be exercised to choose a welding procedure that can reduce the risk of burn through and the formation of very high hardness levels in the heat-affected zone (HAZ) that can lead to a higher than normal risk of cracking. A state of the art review of hot tap welding on pressurized pipelines has been undertaken. All open literature pertinent to hot tap welding has been examined, cataloged and areas requiring further work identified. A large volume of literature exists for welding on pressurized pipelines but the majority consists of successful accounts of repair work on specific items, rather than any generalized approach. The methods, controls and results of work from industry accounts very widely. No known national standard exists and industry standards vary considerably. 26 refs., 3 figs.

36752 (PR–185-815-Vol.2) **Criteria for hot tap welding further studies: Final report: Volume 2.** Edison Welding Inst., Columbus, OH (USA). ©26 May 1989. 61p. Sponsored by American Gas Association. Available from American Gas Assoc., 1515 Wilson Blvd., Arlington, VA 22209 $25.00.

EWI has developed new criteria for hot tap welding that allows safe welding procedures to be developed easily for all ferritic steels. The approach is based on a simple field measurement of the heat sink capacity of the linepipe, that is, the ability of the linepipe to conduct heat. Subsequent correlation of the heat sink capacity to the cooling rate of the weld will allow the welding engineer to develop suitable welding procedures that reduce the susceptibility to cracking. Gas metal arc welding trails have been conducted on simulated branch and sleeve connections in the laboratory to determine the criteria for cracking when using ER80S-D2 and ER70S-3 consumables. Simulated branch and sleeve connections have been made with various consumables (E7018 and E6010) on live pipelines containing natural gas. The weld cooling rates and the extent of cracking were determined to validate criteria established for safe hot tap welding. The results of this investigation clearly demonstrate the feasibility of producing economical and structurally sound hot tap repairs with a high level of confidence.

0340 Combustion

36753 Laser spark ignition of laminar CH_4/air mixtures. Ho, C.M. (Dept. of Mechanical Engineering, Pennsylvania State Univ., PA (US)); Santavicca, D.A. pp. 78.1-78.4 of Chemical and physical processes in combustion. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-8910124–: 22. chemical and physical processes in combustion fall technical meeting, Albany, NY (USA), 30 Oct - 1 nov 1989).

Spark ignition is widely used in a variety of practical combustion systems, including spark ignition engines, gas turbine combustors, and liquid fueled rocket engines. To date, much of the research on spark ignition has been related to the effects of temperature, pressure, turbulence, fuel to air ratio, and ignition system characteristics on minimum ignition energy. From a practical point of view, however, it is the early flame kernel growth rate which determines the ignition limits of real combustion systems and which is the focus of this study.

04 OIL SHALES AND TAR SANDS

0403 Drilling, Fracturing, and Mining

36754 (SAND–89-1895C) **Spherical element bulking mechanisms for modeling blasting induced rock motion.** Preece, D.S. (Sandia National Labs., Albuquerque, NM (USA)); Taylor, L.M. Sandia National Labs., Albuquerque, NM (USA). [1990]. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900821–1: 3. international symposium on rock fragmentation by blasting, Brisbane (Australia), 26-31 Aug 1990). Order Number DE90009569. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Accurate computer prediction of the muck pile produced by a conventional blast requires modeling of the physics that occurs during the rock motion phase of a blast. The ability to predict the motion and the subsequent muck pile can have a significant economic impact on the mining industry. A new spherical element code called DMC (Distinct Motion Code) has been developed this past year. DMC was designed and written to take advantage or super-computer vector processing capabilities. The efficiency has also been increased through the use of spherical elements, explicit time integration and a new contact search algorithm. When spherical elements were chosen for efficiency, some physically correct mechanisms for capturing the bulking behavior of the rock mass also had to be developed. This paper will treat several mechanisms that were developed to allow spherical elements to exhibit correct bulking behavior. 11 refs., 7 figs.

0404 Oil Production, Recovery, and Refining

Refer also to citation(s) 36696

0405 Properties and Composition

Refer also to citation(s) 36739

36755 Study of eastern and western oil shale minerals activity for hydrodesulfurization (HDS) and hydrodenitrogenaton (HDN) reactions. Shamsi, A. (Morgantown Energy Technology Center, WV (USA)). *American Chemical Society, Division of Petroleum Chemistry, Preprints (USA),* 34(1): 26-35 (Mar 1989). (CONF-8904125–: Comparative studies of various shale oils symposium, Dallas, TX (USA), 9-14 Apr 1989).

This research project studied the effects of eastern and western shale minerals on HDS and HDN reactions of sulfur- and nitrogen-containing model compounds. The earlier part of this investigation showed that shale minerals are capable of desulfurizing thiophene to hydrogen sulfide and hydrocarbons, and that they promote desulfurization, isomerization, and polymerization reactions at the retorting conditions (1). The current work focuses on understanding the catalytic effect of the individual mineral and combusted spent shales for removing sulfur and nitrogen from model compounds.

36756 Characteristics of pyrobitumen and oil obtained from the pyrolysis of Tipton member Green River oil shale. Chong, S.L. (Western Research Institute, Laramie, WY (USA)); Miknis, F.P.; Zhao, X.; Holmes, S. *American Chemical Society, Division of Petroleum Chemistry, Preprints (USA),* 34(1): 71-75 (Mar 1989). DOE Contract FC21-86MC11076. (CONF-8904125–: Comparative studies of various shale oils symposium, Dallas, TX (USA), 9-14 Apr 1989).

The pyrobitumens and oils produced from the Green River oil shale at 375, 400 and 425°C for various reaction times were characterized to obtain information for kerogen decomposition models. The atomic H/C ratio of pyrobitumen decreased with increasing reaction temperature and time. The average molecular weight of pyrobitumen increased with reaction temperature and time, reached a maximum at each temperature, and then decreased. The pyrobitumens contained an extremely high amount of polar materials; the variations of polar materials, nitrogen contents of pyrobitumen, and pyrobitumen amounts followed the same pattern, suggesting that the nitrogen functional groups play an important role during kerogen decomposition. In contrast, the oils contained much lower amounts of polars and had a constant atomic H/C ratio

of 1.70 and an average molecular weight of about 270. Most of the aliphatic hydrocarbons occurred in the oil rather than pyrobitumen after the oil shale pyrolysis.

36757 **Ammonia evolution from western and eastern oil shales.** Oh, M.S. (Lawrence Livermore National Lab., CA (USA)); Crawford, R.W.; Foster, K.G.; Alcaraz, A. *American Chemical Society, Division of Petroleum Chemistry, Preprints (USA),* 34(1): 94-102 (Mar 1989). DOE Contract W-7405-ENG-48. (CONF-8904125–: Comparative studies of various shale oils symposium, Dallas, TX (USA), 9-14 Apr 1989).

The authors measured the real-time evolution of ammonia from two Green River formation oil shales and one Eastern US Devonian oil shale. The ammonia from Green River Formation oil shales has two distinct peaks, while the New Albany oil shale has one broad peak maximizing at a high temperature. The gas phase reactions, such as ammonia decomposition, play an important role at high temperatures for all three oil shales. Heating AP24 under steam released 3.5 times more ammonia than under argon. For Green River Formation Oil shales, the high temperature peak is due to NH_3 from the decomposition of heterocyclic organic N-compounds and Buddingtonite, and the contribution of organic N is significant. The catalytic sites for decomposition reactions seem to be predominantly on the surface of retorting particles and the effect of the reactor wall was small. It is probable that the yield increase in steam is due to inhibition of NH_3 decomposition and also due to the additional yields of NH_3 by steam reacting with organic N species. Future work will be directed to monitoring the evolution of other N-volatiles such as HCN and N_2 and also continuing the study of ammonia with improved experimental techniques.

36758 **Thermal decomposition of DOE reference oil shales.** Miknis, F.P. (Western Research Institute, Laramie, WY (USA)); Terner, T.F.; Glaser, R.R. *American Chemical Society, Division of Petroleum Chemistry, Preprints (USA),* 34(1): 63-70 (Mar 1989). (CONF-8904125–: Comparative studies of various shale oils symposium, Dallas, TX (USA), 9-14 Apr 1989).

Despite the large number of studies that have been conducted on oil shale thermal decomposition, there is a paucity of data on the composition of the reaction products. In particular, there is little information on the nature of the bitumen intermediate, which is often used in kinetic models of oil shale decomposition, but is seldom measured. To bridge this gap, the isothermal decomposition of DOE reference oil shales has been studied in the range of 375 to 440°C. Because the two oil shales have significant differences in their kerogen structures, the results obtained from this study allow for some relevant comparisons to be made on the thermal behavior of the bitumen intermediate.

0410 Environmental Aspects

Refer also to citation(s) 37564

05 NUCLEAR FUELS

0505 Uranium Enrichment

Refer also to citation(s) 36811, 36812

0507 Fuels Production and Properties

Refer also to citation(s) 36800, 36946, 36954, 37369

0508 Spent Fuels Reprocessing

Refer also to citation(s) 36775

36759 (ORNL/TM–11175) **Designing equipment for use in gamma radiation environments.** Vandergriff, K.U. Oak Ridge National Lab., TN (USA). May 1990. 103p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90012050. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

High levels of gamma radiation are known to cause degradation in a variety of materials and components. When designing systems to operate in a high radiation environment, special precautions and procedures should be followed. This report (1) outlines steps that should be followed in designing equipment and (2) explains the general effects of radiation on various engineering materials and components. Much information exists in the literature on radiation effects upon materials. However, very little information is available to give the designer a step-by-step process for designing systems that will be subject to high levels of gamma radiation, such as those found in a nuclear fuel reprocessing facility. In this report, many radiation effect references are relied upon to aid in the design of components and systems. 11 refs., 4 tabs.

0509 Transport, Handling, and Storage

Refer also to citation(s) 36804, 36807, 36808, 37012, 37379

36760 (EGG-M–89378) **Transporting spent and damaged fuel in the United States: Recent experience and lessons learned related to the evolving transportation policy of the US Department of Energy.** Schmitt, R.C. (EG and G Idaho, Inc., Idaho Falls, ID (USA)); Harmon, L.H. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1989]. 6p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-891006–17: Joint international waste management conference, Kyoto (Japan), 23-28 Oct 1989). Order Number DE90012959. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The US Department of Energy, through its Office of Civilian Radioactive Waste Management, is preparing for a large-scale transport effort of shipments of commercial spent nuclear fuel from power reactors to the Federal repository for high-level radioactive waste by developing new cask systems and engaging in a major public outreach program. This paper summarizes experience gained from recent transport actions of the Department of Energy, relates lessons learned therefrom to an evolving policy in the Department, and discusses some aspects of public involvement in such transport activities. 8 refs.

36761 (ORNL/FTR–3080) **[Regulations for the safe transport of radioactive material]: Foreign trip report, September 27–30, 1988.** Pope, R.B. Oak Ridge National Lab., TN (USA). 14 Oct 1988. 29p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC05-84OR21400. Order Number DE90012308. Available from NTIS, PC A03/MF A01 - OSTI.

The purpose of this trip, the travel and per diem of which were paid for by the International Atomic Energy Agency (IAEA), was to serve as a consultant to the IAEA on temperature requirements in the IAEA's Regulations for the Safe Transport of Radioactive Material and the associated support documents. Three consultants were assembled by the IAEA to address various issues relating to the temperatures requirements imposed on radioactive material packages by the IAEA's Regulations for the Safe Transport of Radioactive Material (the Regulations). During the meeting, guidance was provided by submitting a written report to the Standing Advisory Group on the Safe Transport of Radioactive Material (SAGSTRAM). The recommended changes should be made to the Regulations (and its supportive documents) to rectify discrepancies on the current editions with regard to extending Multilateral Shipment Approval requirements to any Type B(M) package which does not satisfy Type B(U) temperature requirements. Additional text in the explanatory supportive document concerning the selection of the temperature requirements was provided.

36762 (ORNL/Sub–89-SD841/1) **Classification of spent nuclear fuel (SNF).** Oak Ridge National Lab., TN (USA); Johnson (E.R.) Associates, Inc., Oakton, VA (USA). Mar 1990. 97p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC05-84OR21400. (JAI–334). Order Number DE90012025. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

This report is one of a series of eight prepared by E. R. Johnson Associates, Inc. (JAI) under ORNL's contract with DOE's OCRWM Systems Integration Program and in support of the Annual Capacity Report (ACR) Issue Resolution Process. The report topics relate

specifically to the list of high-priority technical waste acceptance issues developed jointly by DOE and a utility-working group. JAI performed various analyses and studies on each topic to serve as starting points for further discussion and analysis leading eventually to finalizing the process by which DOE will accept spent fuel and waste into its waste management system. This document discusses the classification of spent nuclear fuels.

36763 (SAND–90-1379C) **StateGEN/StateNET and DOT guidelines: Tools for highway routing of hazardous materials.** Cashwell, J.W. (Sandia National Labs., Albuquerque, NM (USA)); Erickson, C.M.; Brogan, J.D. Sandia National Labs., Albuquerque, NM (USA). [1990]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900573–2: Conference on state/local concerns in transportation of hazardous materials, St. Louis, MO (USA), 14-16 May 1990; TTC–0983). Order Number DE90012763. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Under the sponsorship of the US Department of Energy Office of Defense Programs, Sandia National Laboratories' Transportation Technology Center has developed computerized software to assist state and local governments in determining highway routing alternatives for radioactive materials. The techniques have a still wider application in analyzing route alternatives for all hazardous materials transport activities. The specific techniques discussed in this presentation are the latest update of the StateGEN/StateNET model structure and routing algorithm which contains the codified US Department of Transportation (DOT) Guidelines for Highway Route Controlled Quantity shipments of radioactive materials. 6 refs.

0520 Waste Management

Refer also to citation(s) 36760, 36762, 36798, 36805, 36815, 37012, 37327, 37383, 37592, 37603, 37604, 37614, 37624, 37627, 37663, 37937

36764 (ANL–90/13) **The reaction of glass during gamma irradiation in a saturated tuff environment: Part 4, SRL 165, ATM-1c, and ATM-8 glasses at 1E3 R/h and O R/h.** Ebert, W.L.; Bates, J.K.; Gerding, T.J. Argonne National Lab., IL (USA). May 1990. 185p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract W-31109-ENG-38. Order Number DE90013462. Available from NTIS, PC A09/MF A01; OSTI; INIS; GPO Dep.

The reaction between tuffaceous groundwater and actinide-doped SRL 165 and PNL 76-68 type glasses in a gamma radiation field has been studied at 90°C for periods up to 278 days. The primary effect of the radiation field was the acidification of the leachate through the production of nitrogen acids. Acidification of the leachate was limited by bicarbonate in the groundwater, for all exposures tested. Nonirradiated experiments were performed to represent the lowest limit of radiation exposure. Both irradiated and nonirradiated experiments were performed with and without a tuff monolith present in the reaction vessel. Neither irradiation nor the presence of tuff had a major effect on the extent of glass reaction as measured by the leachate concentrations of various glass species or analysis of the reacted glass surfaces. This report discusses the results of leaching experiments performed in a gamma radiation field and in the absence of a radiation field. 28 refs., 47 figs., 11 tabs.

36765 (BMU–1989-232) **Application of the finite-element program NAMMU for a model of a radioactive waste repository site.** Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten. Bogorinski, P.; Larue, J. Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit mbH (GRS), Koeln (Germany, F.R.). Jun 1989. 82p. (In German). Contract BMU SR 389. (GRS-A–1589). Available from GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.).

The report fully explains the NAMMU computer program applied by GRS for modelling of groundwater flow and radionuclide transport in a repository. The program is verified by a test example, which covers calculation of groundwater flow in a regional model of a hypothetic repository, using a basic data set and parameter variation. The regional model describes a complex hydrogeological system with a sequence of aquifers and aquitards in a synclinal structure. Disturbances to some part caused a dislocation of strata, and aquifers strongly vary in thickness, or pinch out. A basic calculation has been made using suitable hydrogeological data (permeability, porosity). The resulting potential field is selfconsistent and shows a plausible behaviour. Velocities and trajectories have been determined from the pressure field. They reveal a flow following the strata from the groundwater recharge area in the south of the model to the areas in the north, where the aquifers tail out. Velocities in the aquifers, or running terms of water particles along the trajectories are within the scope to be expected considering the model conditions. By a parameter variation, the permeability of the aquitards in the caprock has been increased. In this case, groundwater flow does no longer follows the strata, but reveals an upward bound component, so that trajectories after a certain horizontal course in the aquifer go into the above lying aquitards and proceed vertically to the top. (orig./HP).

36766 (BNL–52235) **Zircaloy cladding performance under spent fuel disposal conditions: Progress report, May 1–October 31, 1989.** Pescatore, C.; Cowgill, M.G.; Sullivan, T.M. Brookhaven National Lab., Upton, NY (USA). Apr 1990. 160p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC02-76CH00016. Order Number DE90012861. Available from NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.

The Brookhaven National Laboratory (BNL) Waste Materials and Environment Modeling (WMEM) Program has been assigned the task of helping the DOE formulate and certify analytical tools needed to support and/or strengthen the Waste Package Licensing Strategy. One objective of the WMEM program is to perform qualitative and quantitative analyses of irradiated Zircaloy cladding. This progress report presents the early findings of an on-going literature evaluation and the results of the numerical implementation of two models of Zircaloy creep. The report only addresses cladding degradation modes within intact, dry waste containers. Additional degradation modes will be considered when the study is expanded to include moist environments and partly failed containers. Further updates of the present analyses will also be provided.

36767 (CEA-DAS–653) **Safety assessment for radiactive waste disposal.** Lewi, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Inst. de Protection et de Surete Nucleaire); Kaluzny, Y.; Izabel, C. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Nov 1989. 11p. (In French). (CONF-891008–: International symposium on safety assessment of radioactive waste repositories, Paris (France), 9-12 Oct 1989). Order Number DE90500774. Available from NTIS (US Sales Only), PC A03/MF A01.

Whatever their type may be, radioactive waste disposals obey to the following principle: to isolate radioactive substances as long as their potential nocivity is significant. The isolation is obtained by confining barriers. The present paper recalls the role and the limits of the different barriers, for each type of disposal. It presents and comments site selection criteria and waste packages requirements.

36768 (CEA-DAS–654) **Performance assessment of alpha wastes disposal in deep geological formations, PACOMA project: granite option.** Brun-Yaba, C. (CEA Centre Nucleaires de Fontenay-aux-Roses 92 - (FR). Inst. de Protection et de Surete Nucleaire); Cernes, A.; Goblet, P.; Mangin, J.P. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Nov 1989. 8p. (In French). (CONF-891008–: International symposium on safety assessment of radioactive waste repositories, Paris (France), 9-12 Oct 1989). Order Number DE90500773. Available from NTIS (US Sales Only), PC A02/MF A01.

After the CEC PAGIS project (for vitrified waste), the PACOMA project has been launched at the end of 1987 for cemented waste. The CEA-IPSN is in charge of the granite option. For the PACOMA project, a representative inventory of this type of waste has been built up, a repository concept (with one variant) has been defined and an adaptation of the near field module, Condiment, of the safety evaluation code MELODIE, has been made in order to take into account the particularities of cemented waste with respect to

the vitrified waste. The best-estimate calculations have been performed on one reference site (the French Auriat Site) which is an outcropping granite and two variants, one representing a coastal granite formation (Barfleur) and the other, a granite with a sedimentary cover (notional British site). Moreover, the sensitivity and uncertainty analysis have been performed in the PACOMA project with a 2D modelling of the geosphere (module METIS of MELODIE code) instead of the 1D modelling (stream tube) previously used in the PAGIS project. After a general presentation of these points, the main results, namely the dose rates obtained through deterministic calculations, and the most important geosphere parameters, are presented.

36769 (CEA-DAS–655) **Sensitivity analysis concerning dose equivalents associated with the disposal of radioactive wastes in deep geological formations.** Lewi, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Inst. de Protection et de Surete Nucleaire); Mejon-Goula, M.J.; Cernes, A.; Brun-Yaba, C. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Nov 1989. 12p. (In French). (CONF-891008–: International symposium on safety assessment of radioactive waste repositories, Paris (France), 9-12 Oct 1989). Order Number DE90500772. Available from NTIS (US Sales Only), PC A03/MF A01.

Even if dose calculations may be performed for nuclear waste repositories in deep geological formations, it is unavoidable that the credibility of the obtained results might be affected by huge incertitudes in connection in particular with a lack of precise knowledge of the different components of the performed evaluations (scenarios, models, parameters). In consequence, this paper presents the approach adopted at the CEA/IPSN for performing sensitivity analysis and some obtained results.

36770 (CEA-DAS–656) **Scenarios used for the evaluations of the safety of a site for adioactive waste disposal in deep geologic formations.** Escalier des Orres, P. Devillers, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Inst. de Protection et de Surete Nucleaire); Cernes, A.; Izabel, C. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Nov 1989. 10p. (In French). (CONF-891008–: International symposium on safety assessment of radioactive waste repositories, Paris (France), 9-12 Oct 1989). Order Number DE90500775. Available from NTIS (US Sales Only), PC A02/MF A01.

The selection and qualificatcn procedure of a site for radioactive wastes disposal in a deep geologic formation, has begun in France in the early eighties. The public authorities, on ANDRA's proposal, has preselected in 1987 four sites, each of them coppresponding to a type, of geologic formations (granite, clay, salt and shale). Within two years, one of these sites will be chosen for the location of an undergound laboratory. The safety analysis for the site's qualification uses evolution scenarios of the repository and its environment, chosen according to a deterministic method. With an appropriate detail level, are defined a reference scenario and scenario with random events.

36771 (CONF-890928–25) **Physical and chemical characteristics of topographically affected airflow in an open borehole at Yucca Mountain, Nevada.** Thorstenson, D.C. (Geological Survey, Reston, VA (USA)); Woodward, J.C.; Weeks, E.P.; Haas, H. Geological Survey, Reston, VA (USA). [1989]. 15p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AI08-78ET44802. From Nuclear waste isolation in the unsaturated zone: FOCUS '89; Las Vegas, NV (USA); 18-21 Sep 1989. Order Number DE90012526. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Borehole UZ6S, on the crest of Yucca Mountain, Nevada Test Site, has exhaled approximately 10^6 m^3 of gas annually during winter months for three successive years. The flow arises from thermal-topographic effects. The average composition of the exhausted gas is: N_2 = 78%, O_2 = 21%, Ar = 0.94%, CO_2 = 0.125%, and CH_4 = 0.2 ppMv. The CO_2 has the following isotopic signature: ^{14}C = 108.5 percent modern carbon (pmc), and $\delta^{13}C$ = 17.1 permil. In the thirty-month observation period, there has been a net flux to the atmosphere of approximately 40 m^3 of liquid water and 1150 kg of carbon. The gas flowing from UZ6S appears to originate in the soil and/or shallow unsaturated zone at Yucca Mountain crest. 25 refs., 6 figs., 4 tabs.

36772 (CONF-900210–Vol.1) **Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education: Volume 1, Overview and general waste management: Proceedings.** Post, R.G. (ed.) (Arizona Univ., Tucson, AZ (USA)). American Nuclear Society (USA). Fuel Cycle and Waste Management Div.; American Society of Mechanical Engineers, New York, NY (USA); USDOE, Washington, DC (USA); Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines. ©1990. 813p. Sponsored by American Nuclear Society; University of Arizona; U.S. DOE Office of Environmental Restoration and Waste Management. From Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990. Available from Arizona Board of Regents, University of Arizona, Tucson, AZ 85721.

This volume contains about 123 papers on waste management. Topics include international waste management programs, environmental restoration plans, transportation of nuclear waste concepts, remedial action, regulations and policy. Individual papers will be indexed and entered on the database separately. (KGD)

36773 (CONF-900679–3) **Classification and disposal of radioactive wastes: History and legal and regulatory requirements.** Kocher, D.C. Oak Ridge National Lab., TN (USA). [1990]. 88p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 1990 Health Physics Society meeting; Anaheim, CA (USA); 24-28 Jun 1990. Order Number DE90012731. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

This document discusses the laws and regulations in the United States addressing classification of radioactive wastes and the requirements for disposal of different waste classes. This review emphasizes the relationship between waste classification and the requirements for permanent disposal.

36774 (CONF-8909338–1) **Operation of a mobile pilot-scale continuous countercurrent ion exchange system for treatment of low-level radioactive wastewaters.** Hall, R.; Brown, C.H. Jr.; Robinson, S.M.; Hewitt, J.D. Oak Ridge National Lab., TN (USA). [1989]. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From HAZTECH international symposium; San Francisco, CA (USA); 27-29 Sep 1989. Order Number DE90012683. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A mobile pilot-scale continuous countercurrent ion exchange (CCIX) system is being operated at the Oak Ridge National Laboratory (ORNL) for the treatment of wastewaters that contain predominantly calcium sodium, and magnesium bicarbonates and are slightly contaminated with ^{90}Sr and ^{137}Cs radioisotopes. A demonstration study is being conducted to evaluate the steady state performance and feasibility of a pilot-scale CCIX column for the selective removal of strontium from the wastewater. Initial test results show that the process sufficiently removes strontium from the water while significantly reducing the volume of secondary waste generation. This process has the potential for effective use in many diverse applications. However, it has not been frequently utilized by industries to date. This study shows that the CCIX process could offer an economical alternative for decontamination of wastewaters containing trace amounts of contaminants prior to discharge into the environment. 7 refs., 3 figs., 2 tabs.

36775 (DOE/NE/44139–58) **The use of the Deep Kerfer for thick, steel-reinforced concrete cutting.** Pezzimenti, D.M.; Vlad, P.M.; Landau, B. West Valley Nuclear Services Co., Inc., West Valley, NY (USA). Aug 1989. 38p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-81NE44139. Order Number DE90011904. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper describes the project during which cutting operations were performed on thick, steel-reinforced concrete structures using the Deep Carfare System. The project involved making modifications to the Equipment Decontamination Room, a cell in the former

nuclear fuel reprocessing plant, as one phase of the Vitrification Facility Construction. 23 figs., 2 tabs.

36776 (DOE/NE/44139–60) **Verification of product quality from process control.** Drobot, A. (comp.); Bunnell, L.R.; Freeborn, W.P.; Macedo, P.B.; Mellinger, G.B.; Pegg, I.L.; Piepel, G.F.; Reimus, M.A.H.; Routt, K.R.; Saad, E. West Valley Nuclear Services Co., Inc., West Valley, NY (USA). 30 Aug 1989. 35p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-81NE44139. Order Number DE90011969. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Process models were developed to characterize the waste vitrification at West Valley, in terms of process operating constraints and glass compositions achievable. The need for verification of compliance with the proposed Waste Acceptance Preliminary Specification criteria led to development of product models, the most critical one being a glass durability model. Both process and product models were used in developing a target composition for the waste glass. This target composition designed to ensure that glasses made to this target will be of acceptable durability after all process variations have been accounted for. 4 refs., 11 figs., 5 tabs.

36777 (DOE/RL–90-09-Rev.1) **Hanford Waste Vitrification Plant foreign alternatives feasibility study: Revision 1.** USDOE Richland Operations Office, WA (USA). May 1990. 58p. Sponsored by U.S. DOE Defense Programs. Order Number DE90011793. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The impacts and uncertainties of changing from the current Hanford Waste Vitrification Plant technology and plant design based on the liquid-fed ceramic melter to the French Ateliers Vitrification La Hague vitrification technology and plant design for vitrifying high-level defense wastes are considered in this report. An evaluation has been made as to whether the change might be a source of significant cost savings. The French Ateliers Vitrification La Hague technology is the only alternative at a sufficiently advanced stage of development to consider as a replacement for the current Hanford Waste Vitrification Plant technology. This study concludes that a significant cost savings could not be realized by changing to the French Ateliers Vitrification La Hague technology and design for the Hanford Waste Vitrification Plant. The study provides a rough comparison of plant costs based on available information. An improved cost estimate could be developed through more detailed study, but it would be unlikely to change the overall conclusion. 7 figs., 3 tabs.

36778 (EGG-M–89465) **Redesign of the PREPP [Process Experimental Pilot Plant] feed, ash discharge and sludge handling systems.** Halford, V.E.; Langford, J.E.; Stewart, R.W.; Gale, L.G. EG and G Idaho, Inc., Idaho Falls, ID (USA). Mar 1990. 8p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-9005123–4: 9. annual international symposium on the incineration of radioactive, hazardous, mixed and medical wastes: incineration conference '90, San Diego, CA (USA), 14-18 May 1990). Order Number DE90012952. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Process Experimental Pilot Plant (PREPP) incineration system is designed for processing mixed (chemical and radioactive) hazardous waste. The facility accepts solid waste contaminated with alpha emitting transuranics (TRU) and incidental quantities of hazardous materials such as solvents and lubricants. PREPP consists of a shredding and feed system for containerized waste, a rotary kiln incinerator with a secondary combustion chamber, an ash cooling and grouting system, and wet offgas cleaning system followed by two stages of HEPA filtration. The facility has underground an extensive test period where a number of improvements to the process and equipment have been identified. The incinerator feed system, ash discharge system and the sludge handling system are areas where improved performance is desired. 6 figs.

36779 (FRCEA-TH–265) **Adaptation of magnesian cements to underground storage of nuclear wastes.** Dufournet, F. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI); Ecole Nationale Superieure des Mines, 75 - Paris (France). 1987. 245p. (In French). Order Number DE90502111. Available from NTIS (US Sales Only), PC A11/MF A01.

The aim of this thesis is the experimental study of magnesium oxychloride cements as filling materials for underground granitic cavities containing high level radioactive wastes. After a bibliographic study, mechanical properties are examined before and after setting, in function of the ratio $MgO/MgCl_2$. Then behavior with water is investigated: swelling, cracking and leaching.

36780 (ORNL/FTR–2845) **[Waste immobilization technology]: Foreign trip report, March 16–April 8, 1988.** McDaniel, E.W. Oak Ridge National Lab., TN (USA). 11 Apr 1988. 32p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90012336. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler inspected two Japanese blast furnace slag production sites, each of which produced a product acceptable for use in the Hanford Grout Program. Meetings were held with trading companies and divisions of the steel companies. Agents for Kawasaki Steel Corporation first expressed little interest in the Hanford Grout Program, but later modified their opinion to one of "interest." Nippon Steel Corporation agents expressed great interest and felt that no potential market was too small. The JGC Corporation Nuclear Research facilities were visited, where much interest was expressed in the Department of Energy's use of cement-based materials in low-level waste (LLW) disposal. At the Korea Advanced Energy Research Institute, an invited seminar was presented on the use of the cement-based materials for immobilization of LLW.

36781 (ORNL/FTR–3114) **[Nuclear waste management]: Foreign trip report, October 6, 1988–November 6, 1988.** McDaniel, E.W. Oak Ridge National Lab., TN (USA). 16 Nov 1988. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE90012275. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler presented a paper at the Twelfth International Symposium on the Scientific Basis for Nuclear Waste Management, Berlin, West Germany, October 9–13, 1988. After the Berlin meeting, the traveler visited nuclear facilities in West Germany, France and the United Kingdom to discuss the use of cement-based waste forms in immobilizing non-high-level waste. The Germans are interested in a cooperative effort in low-level waste (LLW) management. The French are interested in a continued cooperative effort with ORNL. The BNFL engineering staff discussed a cementation plant scheduled to be operational in 1991. The traveler toured the BNFL facility at Sellafield and the cementation plant at the UKAEA facility in Dounreay, UK. 1 fig.

36782 (ORNL/TM–11495) **Conceptual model for radiological performance assessment of low-level-radioactive-waste disposal facilities.** Stevens, M.M. Oak Ridge National Lab., TN (USA). Mar 1990. 31p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC05-84OR21400. Order Number DE90012042. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This document describes components of a conceptual model for performance assessment of the low-level-radioactive-waste disposal facilities operated by Martin Marietta Energy Systems, Inc., for the US Department of Energy (DOE)/Oak Ridge Operations. Radiological performance assessments must be conducted for the low-level-waste facilities to demonstrate compliance with the performance objectives. This report describes the components that must be considered in developing a conceptual model for the assessment of any low-level-waste facility and will serve as a standard and guide in the development of models for specific waste facilities. 3 refs., 11 figs.

36783 (PB–90-182395/XAB) **Nuclear waste: Is there a need for federal interim storage.** Monitored Retrievable Storage Review Commission, Washington, DC (USA). 1 Nov 1989. 197p. Available from NTIS, PC A09/MF A02.

The Congress created the Monitored Retrievable Storage Review Commission to provide a report on the need for a Federal monitored retrievable storage facility (MRS) as part of the Nation's nuclear waste management system. The Commission concludes that the MRS as presently described in the law, which links the

capacity and schedule of operation of the MRS to a permanent geologic repository, cannot be justified. The Commission finds, however, that while no single factor would favor an MRS over the No-MRS option, cumulatively the advantages of an MRS would justify the building of an MRS if: there were no linkages between the MRS and the repository; the MRS could be constructed at an early date; and the opening of the repository were delayed considerably beyond its presently scheduled date of operation. The Commission therefore recommends that the Congress take the following actions: Authorize construction of a Federal Emergency Storage facility with a capacity limit of 2,000 metric tons of uranium; Authorize construction of a User-Funded Interim Storage facility with a capacity limit of 5,000 metric tons of uranium; Reconsider the subject of interim storage by the year 2000.

36784 (PNL–6779) **UNSAT-H Version 2.0: Unsaturated soil water and heat flow model.** Fayer, M.J.; Jones, T.L. Pacific Northwest Lab., Richland, WA (USA). Apr 1990. 281p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE90011794. Available from NTIS, PC A13/MF A01 - OSTI; GPO Dep.

This report documents UNSAT-H Version 2.0, a model for calculating water and heat flow in unsaturated media. The documentation includes the bases for the conceptual model and its numerical implementation, benchmark test cases, example simulations involving layered soils and plant transpiration, and the code listing. Waste management practices at the Hanford Site have included disposal of low-level wastes by near-surface burial. Predicting the future long-term performance of any such burial site in terms of migration of contaminants requires a model capable of simulating water flow in the unsaturated soils above the buried waste. The model currently used to meet this need is UNSAT-H. This model was developed at Pacific Northwest Laboratory to assess water dynamics of near-surface, waste-disposal sites at the Hanford Site. The code is primarily used to predict deep drainage as a function of such environmental conditions as climate, soil type, and vegetation. UNSAT-H is also used to simulate the effects of various practices to enhance isolation of wastes. 66 refs., 29 figs., 7 tabs.

36785 (PNL–7331) **Viscosity, electrical conductivity, and cesium volatility of ORNL [Oak Ridge National Laboratory] vitrified soils with limestone and sodium additives.** Shade, J.W.; Piepel, G.F. Pacific Northwest Lab., Richland, WA (USA). May 1990. 79p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-76RL01830. Order Number DE90011774. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

Engineering- and pilot-scale tests of the in situ vitrification (ISV) process have been conducted for Oak Ridge National Laboratory (ORNL) to successfully demonstrate the feasibility of applying ISV to seepage trenches and pits at ORNL. These sites contain soil that overlies crushed limestone fill; therefore, the ISV process is applied to a soil-limestone mixture. Previous testing indicated that while a good retention level of ^{137}Cs and ^{90}Sr was achieved in the melt, it would be desirable to improve ^{137}Cs retention to 99.99% if possible to minimize activity in the off-gas system. Previous testing was limited to one soil-limestone composition. Both Cs volatility and ISV power requirements are in part dependent on melt temperature and viscosity, which depend on melt composition. The study described in this report determined the effect of varying soil and limestone compositions, as well as the addition of a sodium flux, on melt viscosity, electrical conductivity, and Cs volatility. 10 refs., 15 figs., 9 tabs.

36786 (PNL–7344) **Crucible melts and bench-scale ISV [in situ vitrification] tests on simulated wastes in INEL [Idaho National Engineering Laboratory] soils.** Farnsworth, R.K.; Oma, K.H.; Reimus, M.A.H. Pacific Northwest Lab., Richland, WA (USA). May 1990. 68p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-76RL01830. Order Number DE90011767. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

This report summarizes the results of eight crucible melt tests and three bench-scale in situ vitrification (ISV) test that were performed on simulated metals/soils mixtures containing actual site soils from the Idaho National Engineering Laboratory (INEL). The crucible melt and bench-scale ISV tests are a part of efforts by the Pacific Northwest Laboratory (PNL) to assist the INEL in conducting a treatability study on ISV for application to the mixed waste buried at the INEL subsurface disposal area (SDA). The crucible melt tests were performed to evaluate the effect of various chemical additives and metal oxidation techniques on soil melting temperatures, melt viscosities, metals versus electrode oxidation potentials, and metals incorporation in the glass. The bench-scale ISV tests were performed to supplement the existing ISV data base with information on certain hazardous materials that have not been adequately evaluated in previous ISV tests. These materials included five EP toxicity metals, various volatile organic materials fixed in a cementitious matrix [including carbon tetrachloride (CCl_4), trichloroethylene (TCE), and tetrachloroethylene (PCE)], and asbestos. In addition, the bench-scale test were used to evaluated the effect of the proposed chemical additive on ISV processing performance and product quality. 8 refs., 24 figs., 19 tabs.

36787 (PNL–7355) **Initial tests on in situ vitrification using electrode feeding techniques.** Farnsworth, R.K.; Oma, K.H.; Bigelow, C.E. Pacific Northwest Lab., Richland, WA (USA). May 1990. 37p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE90011779. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report summarizes the results of an engineering-scale in situ vitrification (ISV) test conducted to demonstrate the potential for electrode feeding in soils with a high concentration of metals. The engineering-scale test was part of a Pacific Northwest Laboratory (PNL) program to assist Idaho National Engineering Laboratory (INEL) in conducting treatability studies of the potential for applying ISV to the mixed transuranic waste buried at the INEL subsurface disposal area. The purpose of this test was to evaluate the effectiveness of both gravity fed and operator-controlled electrode feeding in reducing or eliminating many of the potential problems associated with fixed-electrode processing of soils with high concentrations of metal. Actual site soils from INEL were mixed with representative concentrations of carbon steel and stainless steel for this engineering-scale test. 18 refs., 14 figs., 3 tabs.

36788 (SAND–89-0371) **Sandia Sorption Data Management System, Version 2 (SSDMS II): User's manual.** Bayley, S.E. (Science Applications International Corp., Albuquerque, NM (USA)); Siegel, M.D.; Moore, M.; Faith, S. Sandia National Labs., Albuquerque, NM (USA). Jan 1990. 191p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90011255. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

The Sandia Sorption Data Management System (SSDMS II) stores and retrieves trace element sorption data. The data management system has potential applications in performance assessment studies of transuranic high- and low-level, and toxic waste sites. The current version stores information describing the degree of sorption, the compositions of rocks and solutions used in the sorption experiment, and the experimental procedures. This User's Manual describes SSDMS II data searches, creation of new data files, and the merging of new with existing data base files. These extended data bases can be used to examine relationships among experimental variables, mineralogy of the substrate, water composition, and sorption ratios. Examples of using SSDMS II with a data base of radionuclide sorption data are given. 3 figs., 13 tabs.

36789 (SAND–89-7149) **Preliminary identification of scenarios that may affect the escape and transport of radionuclides from the Waste Isolation Pilot Plant, southeastern New Mexico.** Guzowski, R.V. (Science Applications International Corp., Albuquerque, NM (USA)). Sandia National Labs., Albuquerque, NM (USA); Science Applications International Corp., Albuquerque, NM (USA). Apr 1990. 52p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90011787. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Waste Isolation Pilot Plant is being evaluated as a location for the disposal of defense-generated transuranic waste. One of the criteria to be used to determine the suitability of the disposal system is compliance with the Containment Requirements established by the US Environmental Protection Agency. One step in determining compliance is to identify the combinations of events and processes (scenarios) defining possible future states of the

disposal system that may affect the escape of radionuclides from the repository and transport to the accessible environment. A list of previously identified events and processes was adapted to a scenario-selection procedure that develops a comprehensive set of mutually exclusive scenarios through the use of a logic diagram. Four events resulted in the development of 16 scenarios. Preliminary analyses indicate that four scenarios result in no releases. Six scenarios consist of combinations of drilling into a room, drilling into a room and a brine reservoir, and emplacement of withdrawal wells downgradient from the repository. Six additional scenarios consist of these same six combinations with the addition of potash mining and the associated surface subsidence. The 12 retained scenarios will be screened and additional data and information will be used to revise and update these preliminary scenarios where appropriate. 80 refs., 20 figs., 3 tabs.

36790 (SKB-TR--88-32) **SKB annual report 1988: Including summaries of technical reports issued during 1988.** Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Dec 1989. 141p. Order Number DE90631514. Available from NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS.

This is the annual report on the activities of the Swedish Nuclear Fuel and Waste Management Co, SKB. It contains in part 1 an overview of SKB activities in different fields. Part 2 gives a description of the research and development work on nuclear waste disposal performed during 1988. Lectures and publications during 1988 as well as reports issued in the SKB technical report series are listed in part 3. Part 4 contains the summaries of all technical reports issued during 1988. SKB is in charge of a comprehensive research and development program on geological disposal of nuclear waste. The total cost for R and D during 1988 was 123.4 MSEK of which 19.3 MSEK came from participants outside Sweden.

36791 (SKB-TR--89-19) **Characterization of fracture zone 2, Finnsjoen study-site.** Ahlbom, K. (Swedish Geological Co. Uppsala (Sweden)); Smellie, J.A.T. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Aug 1989. 239p. Order Number DE90631518. Available from NTIS (US Sales Only), PC A11/MF A01; OSTI; INIS.

Part 1. Overview of the fracture zone project at Finnsjoen, Sweden. Part 2 Geological setting and deformation history of a low angle fracture zone at Finnsjoen, Sweden. Part 3 Hydraulic testing and modelling of a lowangle fracture zone at Finnsjoen, Sweden. Part 4 Groundwater flow conditions in a low angle fracture zone at Finnsjoen, Sweden. Part 5 Hydrochemical investigations at Finnsjoen, Sweden. Effects of gas-lift pumping on hydraulic borehole conditions at Finnsjoen, Sweden.

36792 (VTT-TIED--1018) **Probabilistic system assessment code SYVAC/FI for safety analysis of nuclear waste disposal.** Poteri, A. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Ydinvoimatekniikan Lab.); Vieno, T. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Jul 1989. 83p. (In Finnish). Order Number DE90631519. Available from NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

Safety analyses of nuclear waste disposal are influenced by a range of uncertainties associated with choice of scenarios, conceptual and mathematical modelling and data. Uncertainties are generally taken into consideration by using conservative assumptions, models and data. Effects of data related uncertainties can be evaluated also quantitatively by means of probabilistic models. Probabilistic performance assessment codes for radioactive waste disposal are being developed and tested within the Probabilistic Systems Assessment Codes User Group (PSAC) of and OECD/NEA. The SYVAC/FI code is a modification of the SYVAC A/C code from the U.K. Department of Environment. A special near-field model has been developed for the PSACOIN Level 1a (deep disposal) intercomparison. Postprocessing, graphical and sensitivity analysis capabilities have been implemented in the system. Some minor modifications have been made also in the geosphere model of SYVAC A/C. The report comprises of description of the SYVAC/FI code and the results obtained in the PSACOIN Level 1a exercise.

36793 (VTT-TIED--1032) **Sampling and monitoring of carbon-14 in gaseous effluents from nuclear facilities: Literature survey.** Snellman, M. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Reaktorilaboratorio). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Aug 1989. 60p. Order Number DE90631520. Available from NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

This study reviews the possibilities from sampling and monitoring C-14 in gaseous effluents from nuclear facilities. After oxidation of various forms of carbon-14 in the off-gas into CO_2 three main processes for trapping are used either separately or in combination. These are sorption, freezing and chemical processes. Absorption in alkaline solutions or solids or molecular sieve adsorption are the most frequently used methods. The main counting methods used are gas proportional counting and liquid scintillation counting.

36794 (VTT-TIED--1073) **Safety and cost evaluation of nuclear waste management.** Vieno, T. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Ydinvoimatekniikan Lab.); Hautojaervi, A.; Korhonen, R. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Nov 1989. 161p. (In Finnish). Project YDI90042. Order Number DE90631507. Available from NTIS (US Sales Only), PC A08/MF A01; OSTI; INIS.

The report introduces the results of the nuclear waste management safety and cost evaluation research carried out in the Nuclear Engineering Laboratory of the Technical Research Centre of Finland (VTT) during the years 1984-1988. The emphasis is on the description of the state-of-art of performance and cost evaluation methods. The report describes VTT's most important assessment models. Development, verification and validation of the models has largely taken place within international projects, including the Stripa, HYDROCOIN, INTRACOIN, INTRAVAL, PSACOIN and BIOMOVS projects. Furthermore, VTT's other laboratories are participating in the Natural Analogue Working Group,k the CHEMVAL project and the CoCo group. Resent safety analyses carried out in the Nuclear Engineering Laboratory include a concept feasibility study of spent fuel disposal, safety analyses for the Preliminary Safety Analysis Reports (PSAR's) of the repositories to be constructed for low and medium level operational reactor waste at the Olkiluoto and Loviisa power plants as well as safety analyses of disposal of decommissioning wastes. Appendix 1 contains a comprehensive list of the most important publications and technical reports produced. They present the content and results of the research in detail.

0530 Environmental Aspects

Refer also to citation(s) 36798, 37592

36795 (LA--11790-MS) **Long-term fate of depleted uranium at Aberdeen and Yuma Proving Grounds: Final report, Phase 1: Geochemical transport and modeling.** Ebinger, M.H.; Essington, E.H.; Gladney, E.S.; Newman, B.D.; Reynolds, C.L. Los Alamos National Lab., NM (USA). Jun 1990. 37p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. Order Number DE90012660. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The environmental fate of fragments of depleted uranium (DU) penetrators in soils and waters at Aberdeen Proving Ground (APG) and Yuma Proving Ground (YPG) is a concern to the Testing and Evaluation Command (TECOM) of the US Army. This report presents the information from preliminary soil and water samples that were collected from the humid woodlands of APG and the arid Sonoran Desert of YPG. Soil samples collected beneath a penetrator fragment of the firing range at APG showed approximately 12% DU by weight in the surface horizon and DU significantly above background to a depth of about 20 cm. Samples of surface water at APG showed U only at background levels, and bottom sediments showed background U levels but with isotopic ratios of DU instead of natural U. Soil samples beneath a penetrator fragment at YPG showed about 0.5% by weight U in the surface horizon, but only background concentrations and isotopic ratios of U between 8 and 20 cm depth. Results from this preliminary study indicate that DU at APG was redistributed primarily be dissolution and transport with water and possibly by migration of DU colloids or DU attached to small particles. Redistribution at YPG, however, was mainly due

to erosion of DU fragments from the impact area and redeposition in washes that drain the area. Proposed work for FY90-FY92 includes additional field sampling, laboratory column studies, and the development of a computer model of DU redistribution at both sites. 39 refs., 11 figs., 5 tabs.

0540 Health and Safety

Refer also to citation(s) 37012, 37375, 37379, 37663, 37667

36796 (CONF-9004218–1) **Emergency preparedness at Oak Ridge National Laboratory, Oak Ridge, Tennessee.** Skipper, M.N. Oak Ridge National Lab., TN (USA). Mar 1990. 82p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Emergency preparedness conference; Oak Ridge, TN (USA); 30 Apr 1990. Order Number DE90012772. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

Emergency preparedness for industry was commonly believed to be an essential responsibility on the part of management. Therefore, this study was conducted to research and accumulate information and data on emergency preparedness at Oak Ridge National Laboratory (ORNL). The objective of this study was to conduct a thorough evaluation of emergency preparedness knowledge among employees to determine if they were properly informed or if they needed more training. Also, this study was conducted to provide insight to management as to what their responsibility was concerning this training. To assess employee emergency preparedness knowledge, a questionnaire was developed and administered to 100 employees at ORNL. The data was analyzed using frequencies and percentages of response and was displayed through the use of graphs within the report. 22 refs., 22 figs.

36797 (DOE/EA–0413) **Environmental assessment for 881 Hillside (High Priority Sites) interim remedial action.** Advanced Sciences, Inc., Arlington, VA (USA). Jan 1990. 124p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90012701. Available from NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

This Environmental Assessment evaluates the impact of an interim remedial action proposed for the High Priority Sites (881 Hillside Area) at the Rocky Flats Plant (RFP). This interim action is to be conducted to minimize the release of hazardous substances from the 881 Hillside Area that pose a potential long-term threat to public health and the environment. This document integrates current site characterization data and environmental analyses required by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or "Superfund" process, into an environmental assessment pursuant to the National Environmental Policy Act (NEPA). Characterization of the 881 Hillside Area is continuing. Consequently, a final remedial action has not yet been proposed. Environmental impacts associated with the proposed interim remedial action and reasonable alternatives designed to remove organic and inorganic contaminants, including radionuclides, from alluvial groundwater in the 881 Hillside Area are addressed. 24 refs., 5 figs., 23 tabs.

36798 (DOE/EH–0142) **Tiger Team Assessment of the Lawrence Livermore National Laboratory.** USDOE Assistant Secretary for Environment, Safety and Health, Washington, DC (USA). Jun 1990. 874p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90011270. Available from NTIS, PC A99/MF A01 - OSTI; GPO Dep.

This report documents the results of the Tiger Team Assessment of the Lawrence Livermore National Laboratory (LLNL) (including the Site 300 area), Livermore, California, conducted from February 26 to April 5, 1990. The purpose of the assessment was to provide the Secretary of Energy with the status of Environment, Safety and Health (E&SH) Programs at LLNL. LLNL is operated by the University of California for the Department of Energy (DOE), and is a multi-program, mission-oriented institution engaged in fundamental and applied research programs that require a multidisciplinary approach. The Tiger Team Assessment was conducted by a team comprised of professionals from DOE, contractors, and consultants.

36799 (DOE/EH/79072–T4) **Fire protection review revisit No. 2, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio.** Hertzer, D.R.; Mattern, L.J.; Voss, R.E. Factory Mutual Research Corp., Norwood, MA (USA). Jun 1990. 86p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC01-88EH79072. (FMRC-J–1-OT1N9.CY). Order Number DE90012516. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report summarizes findings of a fire protection review conducted during January 22–26 and March 5–9, 1990, at the Portsmouth Gaseous Diffusion Plant, Portsmouth, Ohio. The visit included a tour of the facility, water and fire pump tests, a review of records of testing and inspection of fire protection equipment, and an unannounced fire drill to assess fire department preparedness. All recommendations are contained in Sections 2 and 3. Recommendations involving loss potentials of $1 million or more are repeated in Appendix B.

36800 (DOE/NCT–03) **Forecast of criticality experiments needed to support US DOE contractor operations, 1987–1992.** Kolar, O.C. (Lawrence Livermore National Lab., CA (USA)); Anderson, K.J. (eds.); Brown, C.L. Lawrence Livermore National Lab., CA (USA). May 1987. 43p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90013081. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of this report is to provide a point of reference for DOE contractors and others when planning experiments needed to support new and modified production operations. The report will also be used by ENCOG to make recommendations to DOE pertaining to the critically experiment programs for the three DOE Critical Mass Laboratories (at the Los Alamos Critical Experiments Facility, the Hanford Critical Mass Laboratory, and the Rocky Flats Plant critical mass laboratory). This listing further provides for early dissemination to the critically research community of experiment concepts (well before the planning or scheduling of such experiments); this will permit other experimenters to request adjuncts to the experiments, and allow them to contribute to the cost of an experiment to expedite its performance.

36801 (DOE/NCT–05) **Transactions of the criticality alarm systems workshop.** Lawrence Livermore National Lab., CA (USA). [1988]. 185p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48 ;AC05-84OR21400. (CONF-8809144–: Transactions of the criticality alarm systems workshop, Richland, WA (USA), 20-22 Sep 1988). Order Number DE90013080. Available from NTIS, PC A09/MF A01; OSTI; INIS; GPO Dep.

The first Criticality Alarm workshop was held by the US Department of Energy Albuquerque Operations Office in 1985. This second workshop is the first held on an international level. There were 98 persons in attendance. They represented the Department of Energy (DOE) field offices, DOE contractors, the Nuclear Regulatory Commission (NRC), NRC licensees, and agencies in the United Kingdom, France, West Germany, and Japan. Topics were on practices experience, and development. A key value of the workshop was the sharing of critical alarm system experiences, problems, and advances in the state of the art. In addition, several Criticality Alarm Systems (CAS) equipment systems were exhibited. Papers were presented on: nature of criticality accidents; lessons learned from past accidents; application of ANS 8.3 standard; gamma and neutron detection systems; research and development in progress; testing at Oak Ridge and Los Alamos; methods used to place detectors; centralized readout feature; false alarms; trip-point settings; and testing and maintenance. The individual papers have been cataloged separately.

36802 (LA–11823-M) **EXPAC [EXPlosion Analysis Code] user's manual: A computer code for analyzing explosion-induced flow and material transport in nuclear facilities.** Gregory, W.S.; Nichols, B.D. Los Alamos National Lab., NM (USA). Jul 1990. 125p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. Order Number DE90012704. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This user's manual supports the EXPAC computer code, which can predict explosion-induced flows, pressures, and material transport within structures. The code can analyze any arbitrarily interconnected network of building rooms and ventilation systems.

EXPAC is part of a family of computer codes that is designed to provide improved methods of safety analysis for the nuclear industry. The EXPAC code structure is based on the TVENT code, but the numerical solution scheme is quite different and is designed to handle very rapid gas transients. A lumped-parameter formulation is used that includes the effects of inertia and choking. This version of the EXPAC code is particularly suitable for calculating the detailed effects of explosions in the far field by using a parametric representation of the explosive event. A very basic material transport capability is included that models the effects of convection, depletion, entrainment, and filtration of material. The effect of clogged filter systems on the gas dynamics also is taken into account. The code input and several sample problems that illustrate EXPAC's capabilities are included. 53 refs., 50 figs., 2 tabs.

36803 (NUREG/CR–5489) **Biological characterization of radiation exposure and dose estimates for inhaled uranium milling effluents: Final report.** Eidson, A.F. (Inhalation Toxicology Research Inst., Albuquerque, NM (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications; Inhalation Toxicology Research Inst., Albuquerque, NM (USA). Jun 1990. 85p. Sponsored by Nuclear Regulatory Commission. (LMF–124). Available from NTIS, PC A05/MF A01 - GPO; OSTI; INIS.

The problems addressed are the protection of uranium mill workers from occupational exposure to uranium through routine bioassay programs and the assessment of accidental worker exposures. Comparisons of chemical properties and the biological behavior of refined uranium ore (yellowcake) are made to identify important properties that influence uranium distribution patterns among organs. These studies will facilitate calculations of organ doses for specific exposures and associated health risk estimates and will identify important bioassay procedures to improve evaluations of human exposures. Samples of airborne uranium from operating mills and deposition models were used to predict appreciable deposition rates in the upper respiratory tract of workers, if respiratory protection were not used. A biokinetic model of retention and excretion of yellowcake inhaled by Beagle dogs was developed. Comparison of the results with available data from human exposures showed that organ burdens in an exposed worker can be estimated from urinary bioassay results and in vivo counting, if the chemical composition, or soluble fraction, of the inhaled yellowcake is known. 34 refs., 31 figs., 24 tabs.

36804 (ORNL–6591) **Doses to railroad workers exposed to shipments of high-level radioactive waste.** Oak Ridge National Lab., TN (USA). Jun 1990. 34p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE90011301. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Based on the maximum dose rate permitted by US Department of Transportation Regulations, potential radiation doses to railroad workers have been calculated using water activity data obtained from CSX Transportation, Inc (CSXT). These doses may result from the handling of shipments of radioactive material contained in large shipping casks. Two worker activity scenarios were considered, a Regular Train Service and Car Repair Service scenario. Two dose models (a point source and line source) were constructed to predict the relative radiation dose rate as a function of distance from the source. The two dose rate models were applied to both the Regular Train Service and Car Repair Service scenarios. 47 refs., 4 figs., 12 tabs.

36805 (ORNL/M–1149) **Environmental compliance assessment findings for Weldon Spring Site Remedial Action Program.** Sigmon, C.F.; Levine, M.B. Oak Ridge National Lab., TN (USA). 2 Mar 1990. 39p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90012974. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report presents the results of an environmental assessment conducted at Weldon Spring Site Remedial Action Project (WSSRAP) in St. Charles County, Missouri, in accordance with the Formerly Utilized Sites Remedial Action Program (FUSRAP) Environmental Compliance Assessment Checklists. The purpose of this assessment was to evaluate the compliance of the site with applicable federal and Missouri environment regulations. Assessments activities included the following: review of site records, reports ,and files; inspection of the WSSRAP storage building, other selected buildings, and the adjacent grounds; and interviews with project personnel. This assessment was conducted on August 28-30, 1989. The assessment covered five management areas as set forth in the Checklist: Hazardous Waste Management, Polychlorinated Biphenyls (PCBs) Management; Air Emissions; Wastewater Discharges and Petroleum Management. No samples were collected. 1 ref., 2 figs., 1 tab.

36806 (ORNL/TM–11535) **Comprehensive Self-Assessment and Upgrade Program (CSAUP) performance objectives and criteria.** Oak Ridge National Lab., TN (USA). May 1990. 71p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90011281. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The US Department of Energy (DOE) has placed strong emphasis on a new way of doing business patterned on the lessons learned in the nuclear power industry after the accident at Three Mile Island Unit 2. The new way relies on strict adherence to policies and procedures, a greatly expanded training program, and much more rigor and formality in operations. Another key element is more visible oversight by upper management and auditability by DOE. Although the Chemical Technology Division (Chem Tech) has functioned in a safe manner since its beginning, the policies and methods of the past are no longer appropriate. Therefore, in accordance with these directives, Chem Tech is improving its operational performance by making a transition to greater formality in the observance of policies and procedures and a more deliberate consideration of the interrelationships between organizations at ORNL. This transition to formality is vitally important because both our staff and our facilities are changing with time. For example, some of the inventors and developers of the processes and facilities in use are now "passing the torch" to the next generation of Chem Tech staff. Our facilities have also served us well for many years, but the newest of these are now over 20 years old! All have increasing needs of refurbishment and repair, and some of the older ones need to be replaced. This procedure, based on the lessons learned in the nuclear industry, will enhance Chem Tech's operational performance in some important ways, while maintaining the special factors that have allowed the Chem Tech staff to be creative and successful in the RD&D activities.

36807 (SAND–90-7025C) **Transportation accidents/incidents involving radioactive materials, (1971–1989).** Cashwell, C.E. (G2vanTel Ltd., Albuquerque, NM (USA)). Sandia National Labs., Albuquerque, NM (USA). [1990]. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900573–1: Conference on state/local concerns in transportation of hazardous materials, St. Louis, MO (USA), 14-16 May 1990). Order Number DE90012762. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Radioactive Materials Incident Report (RMIR) database contains information on transportation-related accidents and incidents involving radioactive materials. The RMIR was developed at Sandia National Laboratories to support its research and development efforts for the US Department of Energy. This paper will address the following topics: background information on the regulations and process for reporting a hazardous materials transportation incident, overview data of radioactive materials transportation accidents and incidents, and additional information and summary data on how packaging has performed in accident conditions. 1 ref., 4 tabs.

36808 Transportation of nuclear materials: A concern for local governments. Zelinski, R.W. (Public Technology, Inc., Washington, DC (USA)); Harmon, L.H. pp. 620-623 of Proceedings of the 6th national conference on hazardous wastes and hazardous materials. Hazardous Materials Control Research Institute, Silver Spring, MD (USA) (1989). (CONF-890452–: 6. national conference and exhibition on hazardous wastes and hazardous materials, New Orleans, LA (USA), 12-14 Apr 1989).

The United States Department of Energy's Transportation Management Division (TMD) is responsible for assuring that the Department's shipments of nuclear materials are made in a safe, secure, efficient and economic manner. While stringent regulatory standards for materials packaging, carrier training and shipment routing are designed and followed to ensure a high level of f =

safety in transportation, concerns about the risks of such shipments are often significant within communities along a shipping route. To address these concerns, DOE/TMD is 1988 began a cooperative program with public safety, health and planning professionals from the large city and urban county membership of the Urban Consortium for Technology Initiatives. With a focus on local issues, these practitioners defined a series of general concerns and assistance needs in areas of coordination, training, information and responder resources, marking and placarding, and costs and education.

0550 Safeguards, Inspection, and Accountability

Refer also to citation(s) 38346

36809 (BNL–52219) **International safeguards: Accounting for nuclear materials.** Brookhaven Lecture Series No. 245. Fishbone, L.G. Brookhaven National Lab., Upton, NY (USA). 28 Sep 1988. 20p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC02-76CH00016. Order Number DE90012751. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Nuclear safeguards applied by the International Atomic Energy Agency (IAEA) are one element of the "non-proliferation regime", the collection of measures whose aim is to forestall the spread of nuclear weapons to countries that do not already possess them. Safeguards verifications provide evidence that nuclear materials in peaceful use for nuclear-power production are properly accounted for. Though carried out in cooperation with nuclear facility operators, the verifications can provide assurance because they are designed with the capability to detect diversion, should it occur. Traditional safeguards verification measures conducted by inspectors of the IAEA include book auditing; counting and identifying containers of nuclear material; measuring nuclear material; photographic and video surveillance; and sealing. Novel approaches to achieve greater efficiency and effectiveness in safeguards verifications are under investigation as the number and complexity of nuclear facilities grow. These include the zone approach, which entails carrying out verifications for groups of facilities collectively, and randomization approach, which entails carrying out entire inspection visits some fraction of the time on a random basis. Both approaches show promise in particular situations, but, like traditional measures, must be tested to ensure their practical utility. These approaches are covered on this report. 15 refs., 16 figs., 3 tabs.

36810 (Juel-Spez–541) **Game theoretical analysis of safeguards effectiveness. Pt. 3. Equilibrium solutions.** Avenhaus, R. (Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.)); Canty, M.J. Kernforschungsanlage Juelich GmbH (Germany, F.R.). Programmgruppe Technik und Gesellschaft. Dec 1989. 28p. Order Number DE90501255. Available from NTIS (US Sales Only), PC A03/MF A01.

In Part 1 of the present study on safeguards effectiveness it was shown that for attribute sampling problems the guaranteed probability of detection can be used as a measure for the effectiveness of safeguards procedures. In Part 2 this measure was used for variable sampling problems, with given false alarm probabilities as boundary conditions. In Part 3 we show that the measure can be justified by appropriate game theoretical models. Furthermore, we show that, for attribute sampling, the equilibrium strategy of the operator is legal behavior if appropriate effort conditions are fulfilled, whether or not the inspector announces his strategy in advance. For variable sampling, legal behavior is equilibrium strategy of the operator only if the inspector announces his strategy. (orig.).

36811 (K/ITP–343/Pt.3) **Safeguards training course: Nuclear material safeguards for enrichment plants: Part 3, Uranium enrichment plant: Description, material control and accountability procedures, and safeguards.** Oak Ridge Gaseous Diffusion Plant, TN (USA). Jun 1990. 409p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. (CONF-9006192–Pt.3: Safeguards training course on nuclear material safeguards for enrichment plants, Luxembourg (Luxembourg), 18-22 Jun 1990). Order Number DE90012220. Available from NTIS, PC A18/MF A01 - OSTI; GPO Dep.

The main objective of this training course is to provide the participants with the necessary skills to perform inspection activities at enrichment plants. This volume, Part 3, gives a description of a uranium enrichment plant and procedures for materials control, accountability, and safeguards. (FSD)

36812 (K/ITP–343/Pt.4) **Safeguards training course: Nuclear material safeguards for enrichment plants: Part 4, Gas centrifuge enrichment plant: Diversion scenarios and safeguards activities.** Oak Ridge Gaseous Diffusion Plant, TN (USA). Jun 1990. 315p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OT21400. Order Number DE90012611. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

The main object of this course is to provide the participants with the necessary skills to perform their inspection activities at enrichment plants. This volume is part four. (FSD)

36813 (PB–90-194937/XAB) **Special nuclear material information, security classification guidance. Instruction.** Flickinger, A. Office of the Deputy Under Secretary of Defense for Policy, Washington, DC (USA). 3 Dec 1982. 5p. (DOD-I–5210.67). Available from NTIS, PC A01/MF A01.

The Instruction reissues DoD Instruction 5210.67, July 5, 1979, and provides security classification guidance for information concerning significant quantities of special nuclear material, other than that contained in nuclear weapons and that used in the production of energy in the reactor plant of nuclear-powered ships. Security classification guidance for these data in the latter two applications is contained in Joint DoE/DoD Nuclear Weapons Classification Guide and Joint DoE/DoD Classification Guide for the Naval Nuclear Propulsion Program.

36814 (SAND–90-0806) **Redundant and independent containment and surveillance systems.** Drayer, D.D. (Sandia National Labs., Albuquerque, NM (USA)); Sonnier, C.S.; Mangan, D.L.; Walford, F. Sandia National Labs., Albuquerque, NM (USA). Apr 1990. 31p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC04-76DP00789. (ISPO–314;SRDP-R–163). Order Number DE90011254. Available from NTIS, PC A03/MF A01; GPO Dep.

Facilities are now coming under Agency safeguards which have large amounts of nuclear material and/or nuclear material which is very difficult to access for reverification. Containment and Surveillance (C/S) technologies may be used to assist in resolution of this problem. This study examines the concept of redundant and independent C/S Systems, and discusses how these systems could be used to lower the need for remeasurement of materials which are difficult to access, or materials included in very large inventories. This paper dose not address increasing levels of C/S measures to protect different types of materials. However, the paper does discuss how redundant and independent C/S Systems will improve the reliability of safeguards information. Equipment which may be used in such systems, and examples of potential systems, are presented. Decisions on how much C/S equipment is enough for a given facility, or type of material, must be made by the inspectorate. 6 refs., 4 figs.

0560 Legislation and Regulations

Refer also to citation(s) 36761, 36773, 36807

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

Refer also to citation(s) 37960

36815 (BNWL-CC–2245) **Interim report on low-cost cesium radiation sources from Hanford Waste Management Program.** Van Tuyl, H.H.; Fullam, H.T.; Mudge, L.K. Pacific Northwest Lab., Richland, WA (USA). Jul 1969. 20p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. Order Number DE90013441. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Hanford Waste Management Program (HWMP) is sponsored by the Division of Production to permit safe disposal of radioactive

wastes at minimum costs. Because of the low rainfall, low water table and low population density at Hanford, the bulk fission products can be stored safely as salt cakes in existing underground waste storage tanks. Heat from ^{90}Sr and ^{137}Cs would prevent solidification for many years if these isotopes were not removed from bulk wastes. Minimum costs at Hanford are achieved by isolating strontium and cesium from the wastes, purifying each element separately, and encapsulating the purified material for long-term storage. Use of relatively high purity material permits storage in fewer containers, thus effecting savings which more than offset the cost of chemical processing to provide the required purities. Although the program sponsored by the Division of Production is intended solely to provide economic waste disposal, the containers made in this program may have utility as heat and radiation sources. The Division of Isotopes Development is sponsoring a supplementary program to evaluate the cesium product from HWMP for utilization in radiation sources. This report, as part of the DID study, provides an interim evaluation of the industrial interest in source as conceived for the Division of Production HWMP, and a brief description of future work to be done for the DID program. 3 refs., 9 figs.

36816 (CONF-900814–3) **The advanced neutron source reactor: An overview.** West, C.D. Oak Ridge National Lab., TN (USA). [1990]. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 7. ASTM-EURATOM symposium on reactor dosimetry; Strasbourg (France); 27-31 Aug 1990. Order Number DE90012802. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The Advanced Neutron Source (ANS) will be a new user facility for all kinds of neutron research, including neutron scattering, materials testing, materials analysis, isotope production and nuclear physics experiments. The centerpiece of the facility is to be the world's highest flux beam reactor. There will be beams of hot, cold and thermal neutrons for more than 40 simultaneous scattering and nuclear physics experiments. In addition, there will be irradiation positions and rabbit tubes for in-pile experiments, testing and isotopes production (including transuranium isotopes). To reduce technical risks and to minimize safety issues, the reactor design is based on technology already employed in existing research reactors. The fuel elements are annular assemblies of aluminum clad involute fuel plates, similar to the design of the High Flux Isotope Reactor (HFIR) at Oak Ridge and the Institut Laue-Langevin (ILL) Reactor in Grenoble. As is common with many other research reactors, the core is cooled, moderated and reflected by heavy water. The preferred fuel is U_3Si_2 - a high-density fuel form developed by Argonne National Laboratory and Babcock and Wilcox that has been extensively tested in reactors in the United States, Europe and Japan. 7 figs., 2 tabs.

36817 (JAERI-M–89-228) **Proceedings of the international symposium on radiation vulcanization of natural rubber latex.** Machi, Sueo (ed.) (Japan Atomic Energy Research Inst., Takasaki, Gunma (Japan). Takasaki Radiation Chemistry Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1990. 423p. (CONF-8907195–: 1. international symposium on radiation vulcanization of natural rubber latex, Tokyo (Japan), 26-28 Jul 1989). Order Number DE90798860. Available from NTIS (US Sales Only), PC A18/MF A01.

The First International Sympqsium on Radiation Vulcanization of Natural Rubber Latex (RVNRL) was held from 26 to 28 July 1989 at Tokyo and Takasaki. In these proceedings, thirty six papers presented at the Symposium are compiled. Main topics are commercial application of RVNRL, characterization of NR latex and vulcanization, properties of radiation vulcanized NR latex, development of sensitizers, mechanism of RVNRL, RVNRL with electron beams, and new Co-60 irradiator for RVNRL. Absence of nitrosamines and low cytotoxicity of radiation vulcanized NR latex are recognized as the remarkable advantages of RVNRL. The radiation vulcanization process for the production of protective rubber gloves for radioactive contamination was presented as the first commercial success in RVNRL. It was reported that various kinds of rubber articles for medical uses have being developed in West Germany. A sensitizer system consisting of n-butyl acrylate and t-butyl hydroperoxide was found to reduce the vulcanization dose to 8 kGy. (author).

36818 (ORNL–6574) **Advanced Neutron Source (ANS) Project progress report.** McBee, M.R. (Oak Ridge National Lab., TN (USA)); Chance, C.M. (eds.); Selby, D.L.; Harrington, R.M.; Peretz, F.J. Oak Ridge National Lab., TN (USA). Apr 1990. 98p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012741. Available from NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

This report discusses the following topics on the advanced neutron source: quality assurance (QA) program; reactor core development; fuel element specification; corrosion loop tests and analyses; thermal-hydraulic loop tests; reactor control concepts; critical and subcritical experiments; material data, structural tests, and analysis; cold source development; beam tube, guide, and instrument development; hot source development; neutron transport and shielding; I&C research and development; facility concepts; design; and safety.

0703 Isotopic Power Supplies

Refer also to citation(s) 37043

08 HYDROGEN

0801 Production

36819 (DOE/ER/13713–4) **Genetics and molecular biology of hydrogen metabolism in sulfate reducing bacteria: Progress report, May 1, 1987–December 1, 1989.** Wall, J.D. Missouri Univ., Columbia, MO (USA). Dept. of Biochemistry. [1990]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER13713. Order Number DE90012692. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The work proposed to be accomplished in the previous funding period was to develop a procedure for genetic exchange based on conjugation mediated by broad host-range plasmids. Such a system has recently been identified that employs IncQ group plasmids and a Desulfovibrio desulfuricans G100A derivative as recipient. During the search for conjugation, we also identified a defective bacteriophage capable of generalized transduction of fragments of chromosomal DNA between mutants of Desulfovibrio desulfuricans. Some of the factors influencing the production and transduction by this defective phage have been investigated. A curious observation was made concerning the response of colonies of these sulfate-reducing bacteria upon exposure to air. All the cells of a colony do not die. Some survive, most likely by producing sulfide at a rate sufficient to provide an anaerobic environment. Dramatic colony morphological changes occur and these have been documented by scanning and transmission electron microscopy. Finally a small endogenous plasmid has been isolated from Desulfovibrio desulfuricans G100A. It has been stably subcloned into a sequencing vector, and nested deletions of this plasmid are being prepared. This plasmid may be useful for the development of a shuttle cloning vector that could be used in more diverse Desulfovibrio. Many of the techniques now to be used in the mutant analysis of hydrogenase genes in the sulfate-reducing bacteria have been successfully applied in an analysis of hydrogenase functions of Rhodobacter capsulatus. 8 figs., 2 tabs.

0802 Storage, Transport, and Handling

36820 **Advanced hydride laboratory.** Motyka, T. (Savannah River Lab., Aiken, SC (USA)). pp. 332 of Proceedings of the 9th Miami international congress on energy and environment. Volume 1-2 (Abstracts). Veziroglu, T.N. Univ. of Miami, College of Engineering, Coral Gables, FL (USA) (1989). (CONF-891210–: 9. Miami international congress on energy and environment, Miami Beach, FL (USA), 11-13 Dec 1989).

Metal hydrides have been used at the Savannah River Tritium Facilities since 1984. However, the most extensive application of metal hydride technology is being planned for the Replacement Tritium Facility, a $140 million facility scheduled for completion in 1990 and start-up in 1991. In the new facility metal hydride technology will be used to store, separate, isotopically purify, pump,

and compress hydrogen isotopes. This paper describes the Advanced Hydride Laboratory, its role and its impact on the application of metal hydride technology of tritium handling.

09 BIOMASS FUELS

0909 Processing

Refer also to citation(s) 37144, 37631, 37632, 37633

36821 (CONF-8808305–1) **Scale-up and performance of an immobilized cell reactor separator for the production of ethanol from whey lactose.** Dale, M.C.; Okos, M.R. Purdue Univ., Lafayette, IN (USA). Dept. of Agricultural Engineering. [1988]. 33p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG02-85CE40772. From Society of Industrial Engineers Meeting (SIM); Chicago, IL (USA); 8 Aug 1988. Order Number DE90012543. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An adsorbed microbial cell, trickle flow, reactor incorporating a circulating gas phase to simultaneously separate a volatile inhibitory product has shown high fermentation rates and effective product separation on a 1 in. diameter lab bench scale. Carbon dioxide generated by the fermentation is recirculated to strip the volatile fermentation product from the fermentation broth. Random and structured packings were evaluated and a parallel type structured packing was developed consisting of a plates of absorbant material to which cells are adsorbed and spaced to allow passage of the circulating gas stream. The substrate solution flows by gravity in a capillary flow fashion down through the plates in which the cells are immobilized. The theoretical reactor separation and fermentation performance as a function of plate thickness and gas channel spacing was evaluated. This reactor has been scaled up to a 6 in. ID reactor with a total reactor volume of about 50 liters using a spiral wound version of the parallel plates, and then to a 24 in. ID reactor with a reactor volume of about 1300 liters. 16 refs., 12 figs., 1 tab.

36822 (FRNC-TH–3567) **Pyrolysis-gasification of biomass. Development of a fluidized bed reactor.** Dif, B. Institut National Polytechnique, 54 - Nancy (France). 1987. 251p. (In French). Order Number DE90501026. Available from NTIS (US Sales Only), PC A12/MF A01.

After a brief of the chemical properties of the wood products, experimental results concerning pyrolysis and gasification of wood products and wastes are analyzed through various processes. A laboratory scale fluidized bed reactor for rapid pyrolysis of wood has been developed and tested. Experimental processes were conducted in similar conditions as those of pilot or industrial plants. Hydrodynamics of this reactor were also studied.

0910 Properties and Composition

36823 Thermal decomposition of methanol in shock waves. Hidaka, Yoshiaki (Ehime Univ., Matsuyama (Japan)); Oki, Takashi; Kawano, Hiroyuki; Higashihara, Tetsuo. *Journal of Physical Chemistry (USA)*, 93(20): 7134-7139 (5 Oct 1989).

The thermal decomposition of methanol behind reflected shock waves with $1372 < T_5 < 1842$ K and $1.81 \times 10^{-5} < \rho_5 < 2.15 \times 10^{-5}$ mol/cm^3 was studied by IR laser kinetic absorption spectroscopy and gas-chromatographic analysis of reaction products. The absorption profiles and product yields were satisfactorily modeled with a 26-reaction mechanism. The initial rate of decrease of IR absorption intensity and the product yields were very sensitive to the rate constants of the reactions $CH_3OH + M = CH_3 + OH + M$, $CH_3OH + H = CH_3 + H_2O$, $CH_3OH + H = CH_2OH + H_2$, and $CH_2OH + M = CH_2O + H + M$. The rate constant expression for the last reaction was derived.

0930 Economic, Industrial, and Business Aspects

Refer also to citation(s) 37144

36824 Alternative transportation fuels: A tax and energy perspective. Coburn, L.L. (U.S. Dept. of Energy, Washington, DC (US)). pp. 134-143 of Energy supply in the 1990s and beyond. International Assoc. of Energy Economists, Washington, DC (USA) (1989). (CONF-8906108–: 11. annual IAEE international conference on energy supply for the 1990's and beyond, Caracas (Venezuela), 26-28 Jun 1989).

The author discusses the role of government, tax policy issues, and energy issues in the context of the development of alternative transportation fuels. Alternative transportation fuels include a broad spectrum of fuels such as ethanol and methanol, compressed natural gas, and electricity. This paper focuses on the alcohol fuels–ethanol and methanol.

10 SYNTHETIC FUELS

1002 Production

Refer also to citation(s) 36697, 37150

1003 Properties and Composition

36825 Solubility of ammonia in pure aqueous and multicomponent solutions. Clegg, S.L. (Plymouth Marine Lab. (England)); Brimblecombe, P. *Journal of Physical Chemistry (USA)*, 93(20): 7237-7248 (5 Oct 1989).

The thermodynamic Henry's law constant (K_H/mol kg^{-1} atm^{-1}) of the weak electrolyte NH_3 is described by the equation $\ln(K_H) = -8.09694 + 3917.507/T - 0.00314T$, from 372 to 313 K. Measured NH_3 solubilities in both pure aqueous and multicomponent solutions agree well with calculations using the Pitzer thermodynamic model to predict osmotic and activity coefficients. Partial pressure and heat of dilution data were used to determine the activity coefficient of NH_3 (γ_{NH_3}). In pure aqueous solutions where dissociation is not significant this is given by $\gamma_{NH_3} = \exp(2m_{NH_3}\lambda_{NH_3NH_3})$, where $\lambda_{NH_3NH_3} = 0.033161 - 21.12816/T + 4665.1461/T^2$ from 273 to 313 K. Ion-NH_3 interaction parameters were obtained by using partial pressure, salt solubility, and partitioning data for the following ions at 298.15 K; Li^+, Na^+, K^+, NH_4^+, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, F^-, Cl^-, Br^-, I^-, OH^-, CNS^-, NO_3^-, NO_2^-, ClO_3^-, ClO_4^-, S^{2-}, SO_3^{2-}, CH_3COO^-, $HCOO^-$ and $(COO)_2^{2-}$. Parameter values are found to be simply related to ion charge and size.

13 HYDRO ENERGY

1303 Plant Design and Operation

36826 (DOE/ID/12481–2) **Inexpensive cross-flow hydropower turbine at the Arbuckle Mountain Hydroelectric Project: Field test report.** Ott Engineering, Inc., Bellevue, WA (USA). Nov 1989. 59p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FC07-84ID12481. Order Number DE90011275. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Arbuckle Mountain Hydroelectric Project represents a Cooperative Agreement between the US Department of Energy (DOE) and Ron and Carlene Ott. The purpose of the project was to build, install in a hydro project, and intensively test an inexpensive American-made cross-flow turbine and to provide information to the DOE on the costs, efficiency, operation, and maintenance of the unit. The data gained from the research and development project will assist in development of cost-effective technology for low-head small hydro sites. The turbine was designed to reduce the cost of manufacturing while making maximum use of the power available in a remote flashy northern California stream. Even with extensive field modifications, the cost of the unit was much less than those quoted by foreign manufacturers for the same site. The new type of cross-flow turbine developed uses an innovative automatic flow control sliding device which allows the unit to produce power at flow ranges of less than 6% of design flow. This coupled with the infinite flow adjustment feature allows detailed flow regulation

needed for small run-of-river projects. The field efficiency testing, the subject of this report, was conducted by Ott Engineering, Inc. in 1988 and early 1989. The tests showed the turbine to have efficiencies in the high seventies and with improvements could reach the efficiencies touted by the European manufacturers of 85% and still be relatively inexpensive to manufacture. It was also found during the tests that the vacuum and depth of water on the runner had a pronounced effect on the turbine output and it is recommended that future research be conducted on these effects, especially for high-vacuum cross-flow turbines. 3 refs.

14 SOLAR ENERGY

1401 Resources and Availability

Refer also to citation(s) 36844, 36850, 36851, 36852, 36853, 36854, 36855

36827 (SERI/PR–215-3617) **SERI Solar Radiation Resource Assessment Project: FY 1989 annual progress report.** Riordan, C.; Hulstrom, R.; Maxwell, E.; Stoffel, T.; Rymes, M.; Myers, D.; Wilcox, S. Solar Energy Research Inst., Golden, CO (USA). May 1990. 56p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE90000307. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The US Department of Energy's (DOE) Resource Assessment Program develops a scientific understanding of and information about the availability and characteristics of renewable energy resources, such as solar energy, used by renewable energy technologies. The program is currently focused on solar radiation resource assessment for the United States. DOE's lead center for solar radiation resource assessment is the Solar Radiation Research and Metrology Branch (SRRMB)* in the Solar Electric Research Division at the Solar Energy Research Institute (SERI). Work is performed at SERI under the Solar Radiation Resource Assessment Project (SRRAP) in the SRRMB. This annual report summarizes the activities and accomplishments of the SRRAP at SERI for the period 1 October 1988 through 30 September 1989, fiscal year (FY) 1989. 27 refs., 15 figs., 1 tab.

36828 (SERI/TP–254-3611) **Passive solar systems performance under conditions in Bulgaria.** Lekov, A.B.; Balcomb, J.D. Solar Energy Research Inst., Golden, CO (USA). Dec 1989. 5p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. (CONF-900923–2: 5. international conference on the physics of highly charged ions, Giessen (Germany, F.R.), 10-14 Sep 1990). Order Number DE89009516. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper presents energy performance of 12 passive solar systems for three climatically different zones of Bulgaria. The results are compared with a base-case residential house that has a design typical for these areas. The different passive solar systems are compared on the basis of the percentage of solar savings and the yield, which is the annual net benefit of adding the passive solar system. The analyses are provided based on monthly meteorological data, and the method used for calculations is the Solar Load Ratio. Recommendations for Bulgarian conditions are given. 5 refs., 4 figs., 1 tab.

36829 (SERI/TR–215-3482) **The effects of urban air pollution on solar radiation.** Riordan, C.J.; Stoffel, T.L.; Hulstrom, R.L. Solar Energy Research Inst., Golden, CO (USA). Dec 1989. 38p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009455. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report contains results of a study examining the effects of urban air pollution on total and spectral solar radiation resources. Researchers reviewed past studies and made measurements during eleven days at an urban site and a nonurban reference site near Denver, Colorado. The measurement period overlapped with the 1987–88 Metro Denver Brown Cloud Study, which provided supporting atmospheric chemistry, visibility, and meteorological data. Based on past studies, investigators expected increased scattering of solar radiation, mainly by fine-particle sulfate, nitrate, and carbon, and increased absorption by nitrogen dioxide, ozone, and elemental carbon at the urban site. Measurements confirmed an increase in the scattering of solar radiation at the urban site. Researchers could not separate extinction due to nitrogen dioxide, ozone, and elemental carbon from extinction due to scattering. 53 refs., 26 figs., 5 tabs.

1403 Economic, Industrial, and Business Aspects

Refer also to citation(s) 36838, 36848, 36857

1405 Solar Energy Conversion

Refer also to citation(s) 37293, 37296

36830 (FRCEA-TH–213) **Photo-oxidation and photoreduction of the ruthenium complex tris (2,2'bipyridine) in an organic medium. Applications to photoelectrochemical cells and photoinduced redox catalysis.** Cano-Yelo, H. CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale; Grenoble-1 Univ., 38 (France). 1986. 187p. (In French). Order Number DE90501039. Available from NTIS (US Sales Only), PC A09/MF A01.

Redox catalysis photoinduced with the ruthenium complex Ru $(bpy)_3^{2+}$ is studied. Two species Ru $(bpy)_3^{3+}$ and Ru $(bpy)_3^{+}$, respectively highly oxidizing and highly reducing, are quantitatively photogenerated by quenching the excited ruthenium complex with respectively an electron acceptor or donor. Aromatic diazonium salts are used as irreversible electron acceptor quenchers. The system Ru $(bpy)_3^{2+}$, $p_RC_6H_4N_2^{+}$ is used as photocathode in a photoelectrochemical cell. The system Ru $(bpy)_3^{2+}$, benzylthiolate is used as photoanode in another photoelectronical cells. Both cell characteristics are studied.

36831 (FRNC-TH–3552) **Study and realization by liquid phase epitaxy of $Ga_{1-y}Al_yAs$ photocells.** Zerdoum, R. Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France). Jul 1987. 104p. (In French). Order Number DE90501038. Available from NTIS (US Sales Only), PC A06/MF A01.

Multispectral conversion of concentrated solar radiation is studied and (Ga, Al)As solar cells are realized for association with silicon solar cells in a dichroic system. Photovoltaic performance are presented for Al content y = 0.2, 0.28 and 0.35.

36832 (IS-T–1469) **Spectral hole burning and flourescence studies of a synthetic chlorophyll dimer, a bacterial antenna system and a bacterial reaction center.** Johnson, S.G. Ames Lab., IA (USA). 13 Jun 1990. 122p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90012447. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Hole burning and fluorescence spectroscopy are applied to a synthetic chlorophyll dimer, an antenna system from the bacterium Prosthecochloris aestuarii and a reaction center from the bacterium Rhodobacter sphaeroides. Information concerning the strength of the linear electron-phonon (exciton-phonon) coupling, inhomogeneous broadening, energy transfer times, nature or structure of the excited states (S_1), the excited state decay times and the vibrational levels of S_1 for these three systems are reported and discussed. A theory for modelling the hole shape and absorption profile for a single transition which is inhomogeneously broadened and coupled to two low frequency modes, with arbitrary coupling strength, is presented and applied to photochemical hole spectra and the absorption profile of the bacterial RC from Rhodobacter sphaeroides. 122 refs., 29 figs.

36833 (ORNL/FTR–2968) **[Biotechnology and photosynthesis]: Foreign trip report, June 28–July 14, 1988.** Greenbaum, E. Oak Ridge National Lab., TN (USA). 5 Aug 1988. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012374. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler was one of two United States (US) scientists who participated in exploratory discussions with Israeli scientists under the newly signed agreement for DOE Basic Energy Sciences/Israel

Ministry of Sciences program of cooperation in scientific research and development. The other US representative was Dr. Arthur Nozik, of the Solar Energy Research Institute. The traveler also had discussions on biotechnology and photosynthesis research at the Universitat Autonoma de Barcelona and the Institut de Biologie Physico-Chimique.

36834 (PIRSEM–2035) **Photovoltaic conversion through thin films organic semiconductors.** Simon, J.; Andre, J.J. Centre National de la Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matiernes Premieres (PRISEM). 1986. 18p. (In French). Order Number DE90501075. Available from NTIS (US Sales Only), PC A03/MF A01.

The molecular semi-conductor concept is first precisely defined and the mechanisms governing the constitution of molecular material-based devices are described. New molecular units such as lutetium phtalocyanines are proposed for the preparation of intrinsic semi-conductors and the construction of inherent devices. A simple model is developed to predict the device properties.

36835 (SAND–90-1258C) **Photovoltaic concentrator module technology.** Richards, E.H.; Chamberlin, J.L.; Boes, E.C. Sandia National Labs., Albuquerque, NM (USA). [1990]. 6p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-900801–1: 25. intersociety energy conversion engineering conference, Reno, NV (USA), 12-17 Aug 1990). Order Number DE90010847. Available from NTIS, PC A02/MF A01 - OSTI.

We are continuing to see significant progress in the development of photovoltaic (PV) concentrator technology. New record cell and module efficiencies have been achieved, and improvements in cells, cell assemblies, and modules are increasing reliability and decreasing cost. The number of firms actively pursuing PV concentrator module technology has increased substantially in the last three years. Two new concentrator systems were installed last year, and more are likely to be installed in the near future. This paper describes the most significant developments of the last two years, including descriptions of advances in PV concentrator cell technology, module development and reliability activities, the new installations, a new Concentrator Initiative Program, and results of the latest costing study. 26 refs., 8 figs., 1 tab.

36836 (SAND–90-1259C) **Reliability of photovoltaic concentrator modules.** Richards, E.H.; Chiang, C.J. Sandia National Labs., Albuquerque, NM (USA). [1990]. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-900542–11: 21. Institute for Electrical and Electronics Engineers photovoltaic specialists conference, Kissimmee, FL (USA), 21-25 May 1990). Order Number DE90012754. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The cost goals and calculations in the Five-Year Plan for the National Photovoltaics Program assume that photovoltaic (PV) concentrator modules "will have a reliable output and an operational life expectancy of 30 years." Although the modules in the few PV concentrator systems fielded to date have so far been reliable, they have not been in the field long enough to establish performance levels for 30 years and are not necessarily representative of newer concentrator designs. Thus, extensive testing and analysis are required to evaluate and establish the reliability of current concentrator module designs. Considerable research has been done to establish appropriate qualification tests, to understand component failure mechanisms, and to obtain reliable materials and designs. Surveys of fielded systems have been conducted and new test and analysis techniques have been developed in the process. This paper discusses the reliability of photovoltaic concentrator modules with an emphasis on the issues that are currently of most concern. 12 refs., 5 figs.

36837 (SAND–90-1260C) **Performance testing and qualification of Sandia's third baseline photovoltaic concentrator module.** Richards, E.H.; Chiang, C.J.; Quintana, M.A. Sandia National Labs., Albuquerque, NM (USA). [1990]. 6p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-900542–10: 21. Institute for Electrical and Electronics Engineers photovoltaic specialists conference, Kissimmee, FL (USA), 21-25 May 1990). Order Number DE90012644. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Sandia designed, built, and tested prototypes of a new photovoltaic concentrator module, the Sandia Baseline Module 3 (SBM3). The SBM3 is intended to be a high-efficiency module that can be readily adapted for commercial production. It consists of a 2 by 12 parquet of lenses arranged with 24 cells in an aluminum housing. The geometric concentration ratio is 185. The cells were made at the University of New South Wales and employ prismatic covers designed by ENTECH. The module features a new concept in cell assemblies in that the cells are soldered directly to a copper heat spreader, eliminating the expensive ceramic wafer and heat sink that have been used in previous designs. Electrical isolation was accomplished by anodizing the electrophoretically coating the aluminum housing. Lessons learned during construction and testing of the SBM3 are presented, along with the outdoor performance characteristics of prototype modules and results from qualification testing. 7 refs., 11 figs.

36838 **Thin film photovoltaic options: An overview.** Stone, J.L. (Solar Electric Research Div., Solar Energy Research Inst., Golden, CO (US)). pp. 383-394 of Amorphous silicon technology-1989. Madan, A.; Thompson, M.J.; Taylor, P.C.; Hamakawa, Y.; LeComber, P.G. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-890426–: Spring meeting of the Materials Research Society, San Diego, CA (USA), 24-28 Apr 1989).

Significant deployment of the promising option of photovoltaics for energy will require cost-effective technologies that compete effectively with conventional sources. One such option utilizes thin films of a variety of photovoltaic materials. These thin films must be manufacturable in large quantities, and they must have high performance and acceptable reliability. Amorphous silicon (a-Si) was the first successfully demonstrated thin film to be widely adopted by industry. This material is watches, and battery chargers. Recently, a-Si solar cells have been scaled up to large-area modules for power applications. Large fields of these modules have been deployed by utility companies for their evaluation. Polycrystalline thin films such as copper indium diselenide (CIS) and cadmium telluride (CdTe) have recently shown promise in following the path of a-Si. High-efficiency, large-area submodules have been successfully tested. By combining these materials in hybrid combinations, researchers have demonstrated much higher efficiencies. Even higher efficiencies have been demonstrated with more conventional materials such as silicon and gallium arsenide in thin-film form. Such devices have a high degree of acceptability because of their successful application for power uses in their non-thin-film form. Examples are given to demonstrate the technical viability of these photovoltaic approaches for possible use in utility-scale power plants and in other near-term, high-value markets.

36839 **Direct measurement of the mobility-lifetime product of holes and electrons in an amorphous silicon p-i-n cell.** Crandall, R.S. (Solar Energy Research Institute, Golden, CO (US)); Sadlon, K.; Kalina, J.; Delahoy, A.E. pp. 423-428 of Amorphous silicon technology-1989. Madan, A.; Thompson, M.J.; Taylor, P.C.; Hamakawa, Y.; LeComber, P.G. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-890426–: Spring meeting of the Materials Research Society, San Diego, CA (USA), 24-28 Apr 1989).

Direct measurements of the electron and hole mobility-lifetime products, $\mu\tau$, on a 10 μm thick hydrogenated amorphous silicon (a-Si:H) p-i-n solar cell are presented. The $\mu\tau$ products, determined from charge collection using strongly absorbed light are $\mu\tau$—h = 2.2 x 10^{-8}cm^{2}V$_{-1}$ and $\mu\tau$—e = 3.0 x 10^{-7}cm^{2}V$_{-1}$s$_{-1}$, for holes, and electrons, respectively. Measurements of the drift length, $l_d = \mu\tau$ —e + $\mu\tau$—h, using uniformly absorbed light and analyzed using the uniform field model, given l_d = 2.9 x 10^{-7}cm^{2}V$_{-1}$s^{-1}. These results are the first experimental evidence that the carrier with the larger $\mu\tau$ product determines the photovoltaic behavior. Evidence for space charge limited transport of photogenerated holes is also presented.

36840 **Stability, performance and trend modeling of amorphous silicon photovoltaic modules.** Mrig, L. (Solar Energy Research Institute, Golden, CO (US)); Berry, W.B. pp. 453-458 of

Amorphous silicon technology-1989. Madan, A.; Thompson, M.J.; Taylor, P.C.; Hamakawa, Y.; LeComber, P.G. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-890426–: Spring meeting of the Materials Research Society, San Diego, CA (USA), 24-28 Apr 1989).

The Solar Energy Research Institute (SERI) has been conducting field tests on amorphous silicon modules and analyzing the results in terms of both stability and performance. Both single p-i-n and tandem modules have been under evaluation for the past few years. This paper presents performance test results for several of these modules. Analytical models for efficiency and fill factor are presented. These models are used to project design lifetime performance. Mean square error curve fitting techniques are used to overcome data scatter. The models bracket best and worst case performance. A phenomena based, double exponential model is included to project end of life performance. This model primarily focuses on degradation due to light induced defects.

36841 Hydrogen-plasma reactive flushing for a Si:H p-i-n solar cell fabrication. Tsuo, Y.S. (Solar Energy Research Institute, Golden, CO (US)); Xu, Y.; Crandall, R.S.; Ullal, H.S.; Emery, K. pp. 471-476 of Amorphous silicon technology-1989. Madan, A.; Thompson, M.J.; Taylor, P.C.; Hamakawa, Y.; LeComber, P.G. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-890426–: Spring meeting of the Materials Research Society, San Diego, CA (USA), 24-28 Apr 1989).

The authors have studied the effects of a hydrogen-plasma reactive flush between the p- and i-layer depositions in fabricating solar cells of glass/TCO/p(a-SiC:H)-i(a-Si:H)-n(a-Si:H)/metal in a single-chamber, glow-discharge deposition system. Spectral response, photoluminescence, and photovoltaic conversion efficiency measurements show that the hydrogen-plasma reactive flush is effective in reducing the p-i-n interface recombination of charge carriers and in improving solar cell perform performance.

36842 Fabrication of minority-carrier-limited *n*-Si/insulator/metal diodes. Kumar, A. (Division of Chemistry and Chemical Engineering, California Institute of Technology, Pasadena, California 91125 (USA)); Rosenblum, M.D.; Gilmore, D.L.; Tufts, B.J.; Rosenbluth, M.L.; Lewis, N.S. *Applied Physics Letters (USA)*, 56(19): 1919-1921 (7 May 1990).

A photoelectrochemical anodization technique has been used to fabricate *n*-Si/insulator/metal (MIS) diodes with improved electrical properties. MIS structures fabricated with Au have provided the first experimental observation of a solid-state *n*-Si surface barrier device whose open circuit voltage V_{oc} is controlled by minority-carrier bulk diffusion/recombination processes. For these diodes, variation of the minority-carrier diffusion length and majority-carrier dopant density produced changes in V_{oc} that were in accord with bulk diffusion/recombination theory. Additionally, the variation in V_{oc} in response to changes in the work function of the metal overlayer indicated that these MIS devices were not subject to the Fermi level pinning restrictions observed for *n*-Si Schottky structures. X-ray photoelectron spectroscopic characterization of the anodically grown insulator indicated 8.2 ± 0.9 A of a strained SiO_2 layer as the interfacial insulator resulting from the photoanodization process.

1406 Photovoltaic Power Systems

Refer also to citation(s) 36838

36843 (DOE/AL–90012657) **SouthWest Region Experiment Station (SWRES) 1989 report.** New Mexico State Univ., Las Cruces, NM (USA). Southwest Technology Development Inst. May 1990. 31p. Sponsored by U.S. DOE Conservation & Renewable Energy. Order Number DE90012657. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report presents a summary of the tasks performed be Southwest Region Experiment Station (SWRES) staff members at the Southwest Technology Development Institute (SWTDI) in 1989. Some of the key tasks were: (1) Testing and evaluating installed photovoltaic systems at Carlsbad, California; Sacramento, California; Jacksonville, Florida; Fallbrook NAS, California; Camp Pendleton, California; Juana Diaz, Puerto Rico; San Diego California; Gardner Massachusetts; Phoenix, Arizona; PVUSA; HOPI Indian Lands; and others; (2) Evaluating and reporting on the performance of amorphous silicon PV systems; (3) Designing hardware for data acquisition systems; (4) Developing software for data analysis; (5) Training engineers from the People's Republic of Mongolia; (6) Producing and presenting a PV workshop to 60 DOD representatives from 17 bases in the Southwest; (7) Producing a Spanish edition of Stand-Alone Photovoltaic Systems–A Handbook of Recommended Design Practices; (8) Revising the English version of the same manual for an additional printing; (9) Designing and building a PV power system for a high-altitude, long-duration balloon flight over Antarctica; and (10) Reviewing the National Electric Code and its relation to PV systems. 11 figs., 5 tabs.

36844 (SAND–90-1201C) **The synthesis of solar radiation data for sizing stand-alone photovoltaic systems.** Chapman, R.N. Sandia National Labs., Albuquerque, NM (USA). [1990]. 19p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-900542–12: 21. Institute for Electrical and Electronics Engineers photovoltaic specialists conference, Kissimmee, FL (USA), 21-25 May 1990). Order Number DE90012758. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Research has shown that long-term hourly insolation data are necessary to properly size stand-alone photovoltaic systems. Even if these data are available, their direct use requires extensive computing capabilities and is not practical on a routine basis. This paper describes a three-step model that generates realistic long-term hourly insolations from average monthly insolations. The model executes rapidly on a personal computer and generates the hourly data needed to properly size stand-alone systems. The approach used to develop this model was unique in that system performance predictions rather than statistical properties were used to verify that the synthetic data were representative of actual data. Results of verification tests show that array sizes resulting from the synthetic data are within 6% of the array sizes resulting from actual hourly data for any system with at least two days of energy storage. 5 figs., 4 tabs.

1407 Solar Thermal Power Systems

36845 (DFVLR-IB–444-011/88) **Research and development program on solar thermal use in the high temperature range.** Koehne, R. Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Stuttgart (Germany, F.R.). Inst. fuer Technische Thermodynamik. Mar 1988. 41p. (In German). Contract BMFT 0328617 A. Available from Deutsche Forschungsanstalt fuer Luft- und Raumfahrt e.V. (DLR), Stuttgart (Germany, F.R.). Inst. fuer Technische Thermodynamik.

In the context of the research project, the physical basis of the direct decoupling of highly concentrated solar radiation in materials without the detour via absorbing heat exchanger walls was examined. Also, the first chemical processes suitable for the effective long-term storage of solar energy were analysed, relevant experiments were carried out and the necessary receiver techniques for high temperature applications were provided. The principle of direct coupling was examined on fluidized beds on the one hand and on cavity receivers, on the other hand. The contribution shows the results achieved in detail. It is recorded that first processes for storing solar energy in chemical reactions were able to be examined. Alkaline earth hydroxides accommodated in ceramic honeycomb structures seem to be possible as stores for medium temperature ranges around 500deg C. Investigations on receiver structure materials are also making progress. Highly transparent, high temperature-resistant aperture covers are a problem here. The concept developed for a volumetric high temperature ceramic network receiver was confirmed in a successful functional test, so that an improved generation was able to be developed and built. (BR).

36846 (SAND–89-1553C) **Results of the design and testing of a porous ceramic absorber for a volumetric air receiver.** Chavez, J.M. (Sandia National Labs., Albuquerque, NM (USA)); Chaza, C. Sandia National Labs., Albuquerque, NM (USA). 10 May 1990. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900801–3: 25. intersociety energy conversion engineering conference, Reno, NV (USA), 12-17 Aug

1990). Order Number DE90011022. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A new absorber for a volumetric receiver was designed, built and tested on an existing volumetric receiver test bed (200 kW_t) at the Plataforma Solar de Almeria test facility in Spain. Volumetric air receivers are currently being investigated for use in solar central receiver power plants because of their inherent simplicity. The volume air receiver is a unique type of solar central receiver that uses a porous absorber (heat exchanger), on which the solar energy is concentrated and absorbed within its volume. Air flows through the absorber, convectively transferring energy from the absorber to the air. Volumetric receivers have applications in electricity production, industrial process heat, and chemical processing. We designed this new volumetric receiver absorber to use a porous ceramic. This material was selected because of its structural strength, high temperature capability, and the potential for using smaller pieces to build up an absorber. The ceramic absorber was tested at the Plataforma Solar de Almeria with a solar flux of up to 1200 kW/m^2, and it produced outlet air temperatures of 730°C. The porous ceramic material has exhibited reasonable thermal efficiencies and excellent structural integrity in the high-flux, high-temperature environment. In this paper we summarize previous tests on the volumetric air receiver and present the current absorber design and test results. 12 refs., 6 figs.

36847 (SAND–90-0268C) **Reflux pool-boiler as a heat-transport device for Stirling engines: On-sun test program results.** Andraka, C.E.; Moreno, J.B.; Diver, R.B.; Ginn, W.C.; Dudley, V.; Rawlinson, K.S. Sandia National Labs., Albuquerque, NM (USA). [1990]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900801–2: 25. intersociety energy conversion engineering conference, Reno, NV (USA), 12-17 Aug 1990). Order Number DE90011021. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The efficient operation of a Stirling engine requires the application of a high heat flux to the relatively small area occupied by the heater head tubes. Previous attempts to couple solar energy to Stirling engines generally involved directly illuminating the heater head tubes with concentrated sunlight. In this study, operation of 75-kW, sodium reflux pool-boiler solar receiver has been demonstrated and its performance characterized on Sandia's nominal 75-kW parabolic-dish concentrator, using a cold-water gas-gap calorimeter to simulate Stirling engine operation. The pool boiler (and more generally liquid-metal reflux receivers) supplies heat to the engine in the form of latent heat released from condensation of the metal vapor on the heater head tubes. The advantages of the pool boiler include uniform tube temperature, leading to longer life and higher temperature available to the engine, and decoupling of the design of the solar absorber from the engine heater head. The two-phase system allows high input thermal flux, reducing the receiver size and losses, therefore improving system efficiency. The receiver design is reported here along with test results including transient operations, steady-state performance evaluation, operation at various temperatures, and x-ray studies of the boiling behavior. Also reported are a fist-order cost analysis, plans for future studies, and the integration of the receiver with a Stirling Thermal Motors STM4-120 Stirling engine. 19 refs., 11 figs.

36848 Optimizing the value-to cost ratio for central receiver electric power plants. Dirks, J.A. (Pacific Northwest Lab., Richland, WA (USA)); Chiang, C.J. *Journal of Solar Energy Engineering (USA)*, 111(3): 193-203 (Aug 1989). DOE Contract AC06-76RL01830.

Typically, solar thermal power plants are designed to minimize the levelized energy cost. However, to maximize the benefit of a solar plant and, hence, maximize the wealth of an investor or a utility, a solar plant should be designed and operated with the objective of maximizing the value-to-cost ratio. This paper describes a value and cost analysis of solar central receiver power plants using molten salt external receiver technology. These plants were assumed to operate within the service area of the Southern California Edison Company. The SOLERGY computer code was used to simulate the performance of the solar plants using 1984 weather data for Barstow, California. A value-maximizing dispatch strategy that uses thermal storage to shift operation of the turbine from nonpeak demand periods to the utility's peak demand period, is shown to greatly increase the value of a solar central receiver power plant with little increase in the levelized energy cost. Results are presented as functions of storage capacity, type of dispatch strategy, size of the field relative to the turbine, and turbine size.

36849 Redirector design for testing surfaces of revolution at central receiver facilities. Ghanbari, C.M. (Energy Research and Development Administration, Washington, DC (USA). Div. of Coal Conversion and Utilization); Mulholland, G.P.; Otts, J.V. *Journal of Solar Energy Engineering (USA)*, 111(3): 260-261 (Aug 1989). DOE Contract AC04-76DP00789.

The purpose of this paper is to discuss the numerous revisions required for the NSTTF computer code, helios, to model a general redirector/surface-of-revolution geometry at a central-receiver-type facility. Obviously, the optical theory required to make the code modifications are extensive and laborious in detail. These details are presented in the paper.

1409 Solar Thermal Utilization

36850 Site, community, and urban planning. Ridley, L. pp. 36-76 of Solar building architecture. Anderson, B. (ed.). The Massachusetts Institute of Technology Press, Cambridge, MA (US) (1990).

The site is by definition the physical point of departure for any building project. The real progress in solar site planning since 1972 has been on the community and urban scale, and it has by necessity combined the efforts of designers, builders, developers, planners, lawyers, and legislators. Government has been involved on the local, state, and federal levels, and researchers in a wide variety of fields from botany to sociology. Over the past decade, they have devised innovative ways to place buildings to maximum advantage-on the site, and in the complex larger scheme of community needs and standards. In virtually every building, the climate is being modified in some way in most modern buildings, by being overpowered with electricity or natural gas. The fundamental tenet of energy conscious site planning is that the climate can be modified using the natural features of the site, thus reducing or in some cases eliminating the need for artificial conditioning. The site's specific microclimate is a complex interaction of many factors: orientation, slope, elevation, surface materials, topography, the velocities and directions of prevailing winds, temperature patterns, humidity, precipitation, vegetation, the presence or absence of water, the seasonal availability of sunlight, and, especially in urban areas, the influence of other buildings. Planning aspects and federal research efforts are briefly examined. Various aspects of several major solar projects are discussed and techniques applied are presented in a matrix table. 91 refs., 3 tabs.

36851 Building envelopes. Prowler, D.; Kelbaugh, D. pp. 77-146 of Solar building architecture. Anderson, B. (ed.). The Massachusetts Institute of Technology Press, Cambridge, MA (US) (1990).

In this chapter, a building envelope is taken to be any surface that separates the thermally conditioned interior of a building from its environment. The building envelope includes roofs, exterior walls, floors, slabs on grade, and foundation walls. Although we will focus on envelope design, it is impossible to separate this issue from whole building design; indeed, one of the accepted measures of good architecture is unity and integration, in which parts are related to the whole and the whole, in turn, to its parts. The envelope of a building, like the skin on our bodies, is called upon to perform a multitude of simultaneous functions in a relatively thin dimension. These functions can be energy related (e.g., to control heat loss from the interior of the building) or nonenergy related (e.g., to present an aesthetic position). Many nonenergy-related requirements are also indirectly related to issues of thermal performance, For example, (1) Aesthetic Concerns, (2) Structural Concerns, (3) Environmental Concerns, and (4) Construction Concerns. Discussion covers, energy-related requirements, design issues, research and development projects and their impacts. 58 refs., 40 figs.

36852 Thermal energy storage in building interiors. Howard, B.D.; Fraker, H. pp. 147-256 of Solar building architecture. Anderson, B. (ed.). The Massachusetts Institute of Technology Press, Cambridge, MA (US) (1990).

Thermal storage is an essential component in the effective use of solar energy in buildings. It acts like a reservoir that absorbs and releases intermittent sources of energy like solar radiation (or large diurnal temperature swings) to assist in providing human comfort. Although many types of solar heating systems use remote storage (such as liquid storage tank, rocks beds, air core systems or phase change materials), this chapter will address those storage techniques that are directly coupled to the interior space of buildings. These are typically surfaces of the interior building structural elements themselves. The heat capacity of interior furnishings and other contents must also be considered. Once the solar thermal storage mechanism becomes an integral part of a building's interior, it has to satisfy many criteria other than just the efficient thermodynamic storage and distribution of energy. Thermal storage and release has to occur within an acceptable temperature range for human comfort. Thermal storage materials may enhance human comfort and also may become part of the interior aesthetic of a building. Its technical function is one of the biggest challenges to solar designers. A major obstacle to the passive solar design is has been having floors you cannot put carpets on, walls you cannot hang things on, or having funny objects and materials in your living room. Also to be considered are the amounts of storage required for good performance and comfort by the climate energy source. Other important internal sources of energy influence the design. The frequency and quantity of internal heat gains supplied or generated by occupants, lights, equipment, and appliances can be as important as the amount of solar energy available. In commercial buildings with rising use of personal computers, entirely new internal gains profiles are experienced, altering design considerations. 50 refs., 63 figs., 8 tabs.

36853 Thermal energy distribution in building interiors. Franta, G. pp. 257-294 of Solar building architecture. Anderson, B. (ed.). The Massachusetts Institute of Technology Press, Cambridge, MA (US) (1990).

Building interiors provide an important element of thermal energy distribution for the effective use of solar energy. The thermal energy distribution in buildings is the final process that provides the common end-use goal of human comfort and safety. By no means are issues of human comfort and safety simple as they relate to the thermal energy distribution in building interiors. Even in the simplest interior environments, consideration should be given to air temperature, mean radiant temperature, air movement, humidity, building function, visual quality, and indoor air quality. These considerations will have a direct or indirect impact on the effective distribution of thermal energy in building interiors. Analyzing internal factors of both small and large buildings can be a difficult task. The internal factors related to thermal energy transfer in building interiors include solar heat gain, internal heat gain, occupancy, lighting, and equipment. The awareness of the interactions among these factors is important when attempting to understand the thermal energy transfers in building interiors. Many of the issues presented in this chapter are often overlooked or are poorly understood by building designers and engineers. This chapter presents the major related research and development as of 1982 on the thermal energy distribution in building interiors. The chapter is divided into two major sections: a background of the topic and a review of research and development between 1972 and 1982. As background information, the key mechanisms and opportunities related to thermal energy distribution in building interiors are summarized in another text. This chapter is intended to augment the information presented in volume 4 in this series. 68 refs., 16 figs.

36854 Architectural integration: Residential and light commercial buildings. Mazria, E. pp. 295-310 of Solar building architecture. Anderson, B. (ed.). The Massachusetts Institute of Technology Press, Cambridge, MA (US) (1990).

This chapter shows the progression of solar architectural integration from ancient to modern times and discusses advances in the state of the art. Sixteen figures illustrate the varying levels of architectural integration, from solar system components mounted on the roof to solar systems comprised of architectural building elements, i.e., walls, floor, roof, finish materials, and fenestrations (figure 6.1). The architectural integration of most active solar energy systems is analogous to the integration of mechanical and electrical equipment in the building design process. As with other applied building technologies, active solar systems integration either falls within the specific expertise of the mechanical and electrical engineer or is practiced as an entirely separate discipline. However, solar and other natural energy systems need not be considered solely as separate mechanical systems, but can be approached as part of the architectural design itself, with solar energy strategies considered throughout the design process and influencing many design decisions. In many instances a combination of both approaches is appropriate in the design of a building. Most of the modern buildings discussed in this chapter use solar energy systems designed as part of the buildings' architectural components, and are skin-load dominated; i.e., exterior climate conditions determine energy consumption for heating and cooling. Internal heat gains from occupants, lights, and equipment do not significantly affect the energy consumption of these buildings. 21 refs., 6 figs.

36855 Nonresidential buildings. Gordon, H.T.; Holton, J.K.; Jones, N.S.; Estoque, J.; Anderson, D.L.; Fisher, W.J. pp. 311-348 of Solar building architecture. Anderson, B. (ed.). The Massachusetts Institute of Technology Press, Cambridge, MA (US) (1990).

A background is provided for the architectural integration of solar strategies. Energy consumption and costs of nonresidential buildings became public issues with the 1973 Arab oil embargo. Energy consumption has increased for space heating and cooling, lighting, and office equipment. Office buildings built in recent years use more energy on the average than do older buildings with an equivalent amount of space (see figure 7.1). The difference can be traced to higher lighting levels, sealed windows (requiring mechanical ventilation), glass curtain walls (allowing high levels of heat loss and gain), and the proliferation of computers, elevators, escalators, electric typewriters, and duplicating machines. Up to 1973, builders of large commercial buildings tended to ignore the climatic environment, including solar resources. Speed of design and construction processes (primarily to reduce initial costs) was desirable and made possible by producing typical building components (standard equipment, catalog systems, etc.) that did not take advantage of the building's specific use, site, and orientation. Integration of general, active and passive considerations in building systems are discussed for the human, economic, and regulatory codes for fire, safety and environmental factors. 25 refs., 15 figs.

36856 (SAND–89-3116C) Engineering-scale experiments of solar photocatalytic oxidation of trichloroethylene. Pacheco, J.; Prairie, M.; Evans, L.; Yellowhorse, L. Sandia National Labs., Albuquerque, NM (USA). [1990]. 5p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-900801–11: 25. intersociety energy conversion engineering conference, Reno, NV (USA), 12-17 Aug 1990). Order Number DE90011474. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A photocatalytic process is being developed to destroy organic contaminants in water. Tests with a common water pollutant, trichlorethylene (TCE), were conducted at the Solar Thermal Test Facility at Sandia with trough systems. Tests at this scale provide verification of laboratory studies and allow examination of design and operation issues that only arise in experiments on a realistic scale. The catalyst, titanium dioxide (TiO_2), is a harmless material found in paint, cosmetics and even toothpaste. We examined the effect of initial contaminant concentration and the effect of hydrogen peroxide on the photocatalytic decomposition of trichlorethylene (TCE). An aqueous solution of 5000 parts per billion (ppB) TCE with 0.1 weight % suspended titanium dioxide catalyst required approximately 4.2 minutes of exposure to destroy the TCE to a detection limit of 5 ppB. For a 300 ppB TCE solution, the time required was only 2.5 minutes to reach the same level of destruction. Adding 250 parts per million (ppM) of hydrogen peroxide reduced the time required by about 1 minute. A two parameter Langmuir Hinshelwood model was able to describe the data. A simple flow apparatus was built to test four fixed catalyst supports and to measure their pressure drop and assess their ability to withstand

flow conditions typical of a full-sized system. In this paper, we summarize the engineering-scale testing and results. 16 refs., 5 figs.

36857 Cost requirements for solar thermal electric and industrial process heat. Edelstein, R. (Gas Research Inst., Chicago, IL (USA)). pp. 337-371 of Economic analysis of solar thermal energy systems. West, R.E.; Kreith, F. The MIT Press, Cambridge, MA (USA) (1988).

This chapter does not provide a cookbook formula for developing goals for energy-related research. There are too many different markets to be satisfied, too many different types of research required (from basic research to applied research to engineering development to field testing to technology transfer), and too many varied technological opportunities to oversimplify the R and D goal-setting procedure. Instead, this chapter is designed to relate to researchers, program managers, and planners some of the experiences encountered in the Solar Thermal Program in its goal selection process.

36858 Experimental study of a self-pumping boiling collector solar hot water system. Davidson, J.H. (Colorado State Univ., Fort Collins, CO (USA). Solar Energy Applications Lab.); Walker, H.A.; Lof, G.O.G. *Journal of Solar Energy Engineering (USA)*, 111(3): 211-218 (Aug 1989).

Results of an experimental study of a full-scale passive solar hot water heating system utilizing a boiling collector are presented. The self-pumping system alternates between two modes of operation. During the run cycle, vapor pressure drives the evaporated refrigerant downward from the collector to the condenser. Once a present quantity of refrigerant is condensed, vapor pressure is again used to force the return of the condensate to the collector during the pump cycle. In order to assess the thermal penalty of self-pumping operation, the system is also operated with a mechanical pump. Daily operating characteristics and seasonal performance are discussed. Performance of the self-pumping system is strongly influenced by the duration of the pump cycle.

1410 Solar Collectors and Concentrators

Refer also to citation(s) 36835, 36847, 36858

36859 (SAND–90-1236C) **Trends in dish-Stirling solar receiver designs.** Diver, R.B.; Andraka, C.E.; Moreno, J.B.; Adkins, D.R.; Moss, T.A. Sandia National Labs., Albuquerque, NM (USA). [1990]. 9p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-900801–10: 25. intersociety energy conversion engineering conference, Reno, NV (USA), 12-17 Aug 1990). Order Number DE90011507. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The dish-Stirling solar energy system, because of its high efficiency, is a leading candidate for producing low-cost electric power from the sun. Dish-Stirling receiver design involves dealing with non-uniform and highly concentrated solar flux at high temperatures (700–800°C) and, therefore, presents a variety of technical challenges. The technology is in the process of evolving from directly illuminated heater-head "tube receivers" to receivers that use refluxing (i.e., gravity assisted) liquid metals as an intermediate heat transfer fluid. Modern dish-Stirling development was initiated in the late 1970s by the Jet Propulsion Laboratory for the Department of Energy. The JPL technology development with United Stirling, Inc. involved the USAB 4.95 Stirling engine and directly illuminated heater-head tube receivers. This work eventually led to the successful demonstrations and world record efficiencies by Advanco Corp., and to the attempted commercialization of the technology by McDonnell Douglas Corp. The severe nature of concentrated solar flux and the potential advantages of heat-pipe technology have caused an evolution toward "reflux" receivers. These receivers are just beginning to be tested in the laboratory and integrated with dish-Stirling systems. In this paper, the history and current status of dish-Stirling receiver development are presented and discussed. The technical challenges to be addressed by the dish-Stirling community and the future plans at Sandia are outlined. 52 refs., 9 figs.

1420 Heat Storage

Refer also to citation(s) 36872, 37116, 37117

15 GEOTHERMAL ENERGY

1502 Geology and Hydrology of Geothermal Systems

36860 (LA-UR–90-987) **Modeling the hydraulic characteristics of the Fenton Hill, New Mexico Hot Dry Rock reservoir.** Robinson, B.A.; Brown, D.W. Los Alamos National Lab., NM (USA). [1990]. 6p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract W-7405-ENG-36. (CONF-900823–3: Annual meeting of the Geothermal Resources Council and international symposium on geothermal energy, Kailua Kona, HI (USA), 20-24 Aug 1990). Order Number DE90008920. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A conceptual model is developed for fluid flow in the Fenton Hill, New Mexico Hot Dry Rock (HDR) geothermal reservoir. The model consists of discrete fractures whose apertures, and hence permeabilities, are strong functions of pressure. Fluid storage occurs within the main fracture system and in the surrounding country rock. Using a fracture network simulator, the reservoir model has been calibrated using reservoir test data obtained at a variety of pressures and flow rates with the system undergoing either circulation or injection with no production. Model results indicate that operating the reservoir with the production well at a higher pressure than is usually used could improve the performance by reducing the pressure difference between the injection and production wells required for circulation. An experiment is designed using numerical simulations to address the following issues: (1) the operating conditions we should employ for the test, (2) the test duration, and (3) the possibility of inducing unwanted reservoir extension. This test is scheduled to be carried out in the late summer of this year. 13 refs., 9 figs.

1503 Geothermal Exploration and Exploration Technology

Refer also to citation(s) 37536

36861 (LA–11779-MS) **Results of investigations at the Ahuachapan geothermal field, El Salvador: Part 1, Well logging and brine geochemistry.** Dennis, B.; Goff, F.; Van Eeckhout, E.; Hanold, B. (comps.). Los Alamos National Lab., NM (USA). Apr 1990. 68p. Sponsored by U.S. Agency for International Development. DOE Contract W-7405-ENG-36. Order Number DE90012424. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Well logging operations were performed in eight of the geothermal wells at Ahuachapan. High-temperature downhole instruments, including a temperature/rabbit, caliper, fluid velocity spinner/temperature/pressure (STP), and fluid sampler, were deployed in each well. The caliper tool was used primarily to determine if chemical deposits were present in well casings or liners and to investigate a suspected break in the casing in one well. STP logs were obtained from six of the eight wells at various flow rates ranging from 30 to 80 kg/s. A static STP log was also run with the wells shut-in to provide data to be used in the thermodynamic analysis of several production wells. The geochemical data obtained show a system configuration like that proposed by C. Laky and associates in 1989. Our data indicate recharge to the system from the volcanic highlands south of the field. Additionally, our data indicate encroachment of dilute fluids into deeper production zones because of overproduction. 17 refs., 50 figs., 10 tabs.

36862 (LA-UR–90-923) **Hydrogeochemical investigations in support of well logging operations at the Zunil geothermal field, Guatemala.** Adams, A. (Los Alamos National Lab., NM (USA)); Golf, F.; Trujillo, P.E. Jr.; Counce, D.; Archuleta, J.; Dennis, B.; Medina, V. Los Alamos National Lab., NM (USA). [1990]. 8p. Sponsored by U.S. Department of State. DOE Contract W-7405-ENG-36. (CONF-900823–5: Annual meeting of the

Geothermal Resources Council and international symposium on geothermal energy, Kailua Kona, HI (USA), 20-24 Aug 1990). Order Number DE90008930. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A suite of 41 thermal and nonthermal waters in the Zunil-Quetzaltenango region, Guatemala, were collected as part of a well logging operation conducted by the Instituto Nacional de Electrificacion (INDE) and Los Alamos National Laboratory. Both in situ and weirbox samples were collected in the Zunil geothermal field. The various data suggest that the reservoir at Zunil is geochemically inhomogeneous. Stable isotope data suggest recharge to the field comes primarily from the north and east whereas tritium data indicate that the reservoir waters may be 500 to 7500 years old. 14 refs., 4 figs., 3 tabs.

36863 (LA-UR-90-932) **Tecuamburro Volcano, Guatemala geothermal gradient core hole drilling, operations, and preliminary results.** Goff, S. (Los Alamos National Lab., NM (USA)); Heiken, G.; Goff, F.; Gardner, J.; Duffield, W.; Martinelli, L.; Aycinena, S.; Castaneda, O. Los Alamos National Lab., NM (USA). [1990]. 5p. Sponsored by U.S. Agency for International Development. DOE Contract W-7405-ENG-36. (CONF-900823-6: Annual meeting of the Geothermal Resources Council and international symposium on geothermal energy, Kailua Kona, HI (USA), 20-24 Aug 1990). Order Number DE90008929. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A geothermal gradient core hole (TCB-1) was drilled to a depth of 700+ m at the Tecuamburro geothermal site, Guatemala during February and March, 1990. The core hole is located low on the northern flank of the Tecuamburro Volcano complex. Preliminary analysis of cores (>98% core recovery) indicates that the hydrothermal system may be centered in the 4-km-diameter Chupadero Crater, which has been proposed as the source of pyroxene pumice deposits in the Tecuamburro area. TCB-1 is located 300 m south of a 300-m-diameter phreatic crater, Laguna Ixpaco; the core hole penetrates the thin edge of a tuff ring surrounding Ixpaco and zones of hydrothermal brecciation within the upper 150 m may be related to the phreatic blast, dated at 2,910 ^{14}C years. At the time of this writing, the unequilibrated temperature at a depth of 570m was 180°C. Data on fracturing, permeability, hydrothermal alteration, and temperature will be presented. 3 refs., 3 figs.

36864 (LA-UR-90-963) **The "Art" of in situ fluid sampling and the remarkable compositional variations in the wellbore fluid of VC-2B, Valles Caldera, New Mexico.** Golf, F. (Los Alamos National Lab., NM (USA)); Gardner, J.N.; Adams, A.; Trujillo, P.E. Jr.; Counce, D.; Solbau, R.D.; Lippert, D.R.; Evans, W.C.; Jacobson, R.; Bayhurst, G. Los Alamos National Lab., NM (USA). [1990]. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-900823-4: Annual meeting of the Geothermal Resources Council and international symposium on geothermal energy, Kailua Kona, HI (USA), 20-24 Aug 1990). Order Number DE90008926. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In situ fluid operations were conducted at VC-2B in January 1990 using two flow-through tools of different designs. Of eight attempts, no runs obtained samples from their intended depth of collection or, if they did, the tools gained additional fluid by inward leakage during their trips back to the surface. Interpretation of the salinity and mass of the fluid samples indicates that they were collected from apparent depths of about 204 to 1045 m, at collection temperatures of about 125° to 240°C. The data show a remarkable two-fold increase in fluid salinity (>9000 versus about 4000 mg/kg Cl) near the top of the well and a relatively thin, dilute "cap" of condensed steam at the top of the water column. Various criteria suggest that these salinity gradients are caused by boiling and condensation of steam in the wellbore during a seven month period of logging, stimulation, flow testing, and other in-hole experiments. 8 refs., 3 figs., 5 tabs.

36865 (PIRSEM-252-1) **A geochemical study of the fluids in several wells: The Momotombo geothermal field.** Sabroux, J.C.; Vuataz, F.D.; Iundt, F.; Fouillac, C. Centre National de la Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matiernes Premieres (PRISEM); Centre National de la Recherche Scientifique, 91 - Gif-sur-Yvette (France). Centre des Faibles Radioactivites. 1987. 25p. (In French). Order Number DE90501074. Available from NTIS (US Sales Only), PC A03/MF A01.

Measure results concerning geothermal waters (4 wells) in the geothermal field at Momotombo (Nicaragua) are presented and explained: temperature of the water reserve, evolution and mass transfer of the deep fluids and evaluation of the dissolved substances in the geothermal fluid.

1505 Economic, Industrial, and Business Aspects

Refer also to citation(s) 36874

36866 (EGG-M-90073) **The geopressured-geothermal resource: Transition to commercialization.** Negus-de Wys, J. (EG and G Idaho, Inc., Idaho Falls, ID (USA)); Dorfman, M. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 9p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-76ID01570. (CONF-900823-10: Annual meeting of the Geothermal Resources Council and international symposium on geothermal energy, Kailua Kona, HI (USA), 20-24 Aug 1990). Order Number DE90012956. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Geopressured-Geothermal resource has an estimated 5700 recoverable quad of gas and 11,000 recoverable quad of thermal energy in the onshore Texas and Louisiana Gulf Coast area alone. After 15 years the program is now beginning a transition to commercialization. The program presently has three geopressured-geothermal wells in Texas and Louisiana. The Pleasant Bayou Well has a 1 MWe hybrid power system converting some gas and the thermal energy to electricity. The Gladys McCall Well produced over 23 MM bbls brine with 23 scf per bbl over 4 1/2 years. It is now shut-in building up pressure. The deep Hulin Well has been cleaned out and short term flow tested. It is on standby awaiting funds for long-term flow testing. In January 1990 an Industrial Consortium for the Utilization of the Geopressured-Geothermal Resource was convened at Rice University, Houston, TX. Sixty-five participants heard industry cost-shared proposals for using the hot geopressured brine. Proposals ranged from thermal enhanced oil recovery to aquaculture, conversion, and environmental clean up processes. By the September meeting at UTA-Balcones Research Center, industry approved charters will have been received, an Advisory Board will be appointed, and election of officers from industry will be held. 11 refs., 8 figs., 1 tab.

1506 Environmental Aspects

36867 (DOE/NV/10425-T1) **Environmental monitoring at designed geopressured-geothermal well sites, Louisiana and Texas: Quarterly status report, April-June 1990.** Louisiana State Univ., Baton Rouge, LA (USA). School of Geoscience. [1990]. 5p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FC07-85NV10425. Order Number DE90013053. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This document covers the activities of monitoring environmental aspects at designated geothermal wells in Texas and Louisiana during the second quarter of 1990 by the Louisiana Geological Survey, Louisiana State University under contract with US DOE. 1 fig. (FSD)

1508 Geothermal Power Plants

36868 (EGG-M-90156) **Advanced binary geothermal power plants: Limits of performance.** Bliem, C.J.; Mines, G.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 8p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-76ID01570. (CONF-9004131-5: The national energy strategy--the role of geothermal technology development, San Francisco, CA (USA), 18-20 Apr 1990). Order Number DE90013093. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Heat Cycle Research Program is currently investigating the potential improvements to power cycles utilizing moderate temperature geothermal resources to produce electrical power. Investigations have specifically examined Rankine cycle binary

power systems. Binary Rankine cycles are more efficient than the flash steam cycles at moderate resource temperatures, achieving a higher net brine effectiveness. At resource conditions similar to those at the Heber binary plant, it has been shown that mixtures of saturated hydrocarbons (alkanes) or halogenated hydrocarbons operating with a supercritical Rankine cycle gave improved performance over Rankine cycles with the pure working fluids executing single boiling cycles. Recently, in addition to the supercritical Rankine Cycle, other types of cycles have been proposed for binary geothermal service. This paper explores the limits on efficiency of a feasibility plant and discusses the methods used in these advanced concept plants to achieve the maximum possible efficiency. The advanced plants considered appear to be approaching the feasible limit of performance so that the designer must weigh all considerations to find the best plant for a given service. 16 refs., 12 figs.

1509 Geothermal Engineering

Refer also to citation(s) 36860, 36868

36869 (BNL–44708) **An initial comparison of pitting resistance of alloys for potential geothermal applications.** Van Rooyen, D. Brookhaven National Lab., Upton, NY (USA). May 1990. 78p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-76CH00016. Order Number DE90012873. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

In order to use the energy available from geothermal sources, brines of a variety of compositions and temperatures have to be handled. Much of the hardware has consisted of metals, such as used in casings, pipes, valves, turbines, heat exchangers and others. When the pH is not very acid, and oxygen is absent, the brines are not very corrosive. However, there are instances where conditions cause accelerated corrosion. The present work was undertaken to examine one particular form of corrosion, pitting, which is encountered fairly often, and causes early failures in many industries because it is so localized. A number of alloys have been examined in the laboratory for their resistance to pitting corrosion in chloride media. The electrochemical procedure of determining pitting potentials was used. It was found that the most meaningful results could be obtained by increasing the aggressiveness of the test solutions as the resistance to localized attack of individual members of the series of alloys increased. The outcome of the experiments was the creation of a ranking of a large number of alloys according to their performance in the laboratory test program. The range of materials tested include carbon steel at the low end, with Hastelloy C-276 and Titanium at the top. 55 figs., 11 tabs.

36870 (LA-UR–90-976) **Progress in hot dry rock technology development.** Duchane, D.V.; Brown, D.W.; House, L.; Robinson, B.R.; Ponden, R. Los Alamos National Lab., NM (USA). [1990]. 6p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract W-7405-ENG-36. (CONF-900823–7: Annual meeting of the Geothermal Resources Council and international symposium on geothermal energy, Kailua Kona, HI (USA), 20-24 Aug 1990). Order Number DE90008921. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The hot dry rock (HDR) geothermal energy program at Los Alamos is directed toward demonstrating the viability of HDR as a practical energy source. Recently, reservoir characterization experiments have been carried out to evaluate water loss and reservoir inflation under pressurized conditions over a long time period. In addition, advances have been made in reservoir engineering, seismic modeling, and tracer development. Preparations are being made to conduct a long term flow test (LTFT) to evaluate the thermal power potential of the existing Phase 2 reservoir at Fenton Hill, New Mexico. The reservoir is located 12,000 ft below the surface and has an estimated capacity of about a million gallons. The LTFT is scheduled to start in 1991 and will run for 1–2 years. This paper summarizes recent developments in all of the above areas. 8 refs., 5 figs., 1 tab.

36871 (SAND–90-0749C) **Evaluation of a potential borehole televiewer technique for characterizing lost circulation zones.** Glowka, D.A. (Sandia National Labs., Albuquerque, NM (USA)); Loeppke, G.E.; Lysne, P.C.; Wright, E.K. Sandia National Labs., Albuquerque, NM (USA). [1990]. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900823–8: Annual meeting of the Geothermal Resources Council and international symposium on geothermal energy, Kailua Kona, HI (USA), 20-24 Aug 1990). Order Number DE90009284. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An experimental study is described that evaluates the potential for using an acoustic borehole television technique to measure fracture dimensions in lost circulation zones encountered in geothermal drilling. A simulated wellbore was constructed of sandstone blocks with adjustable, inclined fractures, stacked in a barrel filled with water. A slim-hole televiewer was used to log the wellbore, and a computer was used to digitize and analyze the data. Televiewer signal perturbations caused by the fractures were studied to evaluate the effects of fracture thickness and signal amplification on the width of the signal perturbation in the digital record. It was found that the signal amplification is applied. Two techniques for determining the correct amplification are described. With the televiewer used in the present study, fractures thicker than 0.15 inch in a 5.1-inch wellbore can be measured to within an accuracy of 5–15%. Fractures as small as 0.031 inch can be detected but cannot be accurately and reliably measured. 1 ref., 15 figs.

1510 Direct Energy Utilization

36872 (AFME–83.0097) **Heat pump and heliogeothermal space heating Aulnay-sous-Bois. The 1985 season.** Iris, P.; Viennot, P. Agence Francaise pour la Maitrise de l'Energie, 75 - Paris (France); Ecole Nationale Superieure des Mines, 75 - Paris (France). Aug 1987. 23p. (In French). Order Number DE90501076. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1985 seasonal performances of the heliogeothermal doublet system at Aulnay sous Bois are presented. During winter, the shallow ground water is pumped and heat is extracted through a heat pump and delivered to buildings. The cold water is re-injected in a second hole. During summer, the previously cooled water is repumped and heated in solar air collectors. The heated water is then re-injected in the ground water for next winter heating season.

1520 Geothermal Data and Theory

Refer also to citation(s) 36861, 36865

36873 (DOE/ER/13408–1) **[Sulfide-oxide-silicate phase equilibria and associated fluid inclusion properties in the Salton Sea geothermal system, California]: Final technical report, September 1, 1985–February 1, 1988.** McKibben, M.A. California Univ., Riverside, CA (USA). Inst. of Geophysics and Planetary Physics. Jun 1988. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-85ER13408. (UCR/IGPP–88/27). Order Number DE90012891. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Our studies involved petrographic, fluid inclusion, geochemical and stable isotopic studies of drillcores and fluids from the Salton Sea geothermal system. Our initial studies revealed the presence of previously-unrecognized evaporitic anhydrite at depth throughout the geothermal system. The high salinity of the Salton Sea geothermal brines previously had been attributed to low-temperature dissolution of surficial evaporitic deposits by meteoric waters. Our microthermometric studies of halite–containing fluid inclusions in the meta-evaporites indicated that the high salinity of the geothermal brines is derived in part from the hydrothermal metamorphism of relatively deeply-buried salt and evaporites. In addition, our research concentrated on mineralized fractures in drillcores.

36874 (DOE/SF/17712–T1) **UCSD geothermal chemistry program: Annual progress report, FY 1989.** Weare, J.H. California Univ., San Diego, La Jolla, CA (USA). Dept. of Chemistry. [1989]. 8p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-88SF17712. Order Number DE90012889. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The development of a geothermal resource requires a considerable financial commitment. As in other energy extraction ventures,

the security of this investment can be jeopardized by the uncertain behavior of the resource under operating conditions. Many of the most significant problems limiting the development of geothermal power are related to the chemical properties of the high temperature and highly pressured formation fluids from which the energy is extracted. When the pressure and temperature conditions on these fluids are changed either during the production phase (pressure changes) or during the extraction phase (temperature changes) of the operation, the fluids which were originally in equilibrium under the new conditions by precipitation of solid materials (scales) or release of dissolved gases (some toxic) in the formation and well bores or in the plant equipment. Unfortunately, predicting the behavior of the production fluids is difficult, because it is a function of many variables. In order to address these problems the Department of Energy is developing a computer model describing the chemistry of geothermal fluids. The model under development at UCSD is based on recent progress in the physical chemistry of concentrated aqueous solutions, and is covered in this report.

17 WIND ENERGY

1706 Wind Energy Engineering

36875 (AFME–84-1724-5) **Dynamic tests of wind turbine metallic blades (Lamboley process).** Bontemps, A.; Crespin, S.; Court, J. Agence Francaise pour la Maitrise de l'Energie, 75 - Paris (France); Office National d'Etudes et de Recherches Aerospatiales (ONERA), 92 - Chatillon (France). Feb 1986. 29p. (In French). Order Number DE90501072. Available from NTIS (US Sales Only), PC A03/MF A01.

The metallic blades produced by the Lamboley company are fabricated through a cold drawing process. The vibration characteristics of the blades have been measured in order to examine their operational stability. The main problem encountered is the poor damping characteristic (less than 1/1000), leading to an important vibratory fatigue.

36876 (AFME–85-05-1038) **Study and development of a mounted compiler for wind turbines.** Notin, C.; Vuillemin, H. Agence Francaise pour la Maitrise de l'Energie, 75 - Paris (France); Office National d'Etudes et de Recherches Aerospatiales (ONERA), 92 - Chatillon (France). Mar 1986. 33p. (In French). Order Number DE90501073. Available from NTIS (US Sales Only), PC A03/MF A01.

A complier to be mounted on the rotor side of a wind turbine has been developed for severe conditions (marine atmosphere for example). It allows the connection of 18 gauges and two sensors needing impedance matching. Included in a data acquisition line in front of a multiplexer, the device ensures the protection of the input circuits and the scaling of the analog voltage derived from the various sensors and their power supply.

36877 (CSTB-EN-CLI–86-5-L) **Wind heating feasibility.** Beguin, D. Centre Scientifique et Technique du Batiment, Etablissement de Nantes, 44 (France). 1986. 62p. (In French). Order Number DE90501024. Available from NTIS (US Sales Only), PC A04/MF A01.

The energy balance of a system consisting of a wind turbine and a building is analyzed, based on experimental results. The space heating system is composed of a hot water storage tank, electrically heated by the wind turbine, and a reserve heating device. The wind turbine dimensions are optimized for this specific application and building. An economic evaluation of the profitability of the system is presented and discussed.

36878 (STEV-VIND–90-7) **Pressure measurements on a 5.35 m hawt in CARDC wind tunnel compared to theoretical pressure distributions.** Ronsten, G. (Aeronautical Research Inst. of Sweden, Bromma (Sweden)); Dahlberg, J.Aa.; Meijer, S.; Dexin, H.; Ming, C. Statens Energiverk, Stockholm (Sweden); Aeronautical Research Inst. of Sweden, Bromma (Sweden). Nov 1989. 12p. (CONF-890717–4: EWEC '89: European wind energy conference and exhibition, Glasgow (UK), 10-13 Jul 1989; FFA-TN–1989-46). Order Number DE90796237. Available from NTIS (US Sales Only), PC A03/MF A01.

Paper presented at the EWEC'89.

Measurements on wind turbines indicate that the real loads are higher than loads calculated using Blade Element/Momentum theory (BEM). Effects of three dimensional flow on a wind turbine blade may explain the discrepancy found between calculated and measured data. In order to investigate the difference between calculated and measured loads on a wind turbine, a wind tunnel test has been performed at CARDC Low Speed Aerodynamics institute. Pressure distributions on a 5.35 m diameter horizontal axis wind turbine have been measured at 8 radial stations at Re numbers ranging from $4x10^5$ to $1.2x10^6$. The measured radial thrust distribution shows higher loading at the root when compared to theoretical flow leave calculations while the tip is less loaded. The maximum power is underpredicted bye the Blade Element/Momentum theory while the power at high tip speed ratios is overpredicted. The total thrust force is overpredicted at high tip speed ratios. The total thrust measured with a six component balance and with pressure transducers agrees well.

36879 The United States Wind Energy Technology Research Program. Rogers, L.J. (Wind/Ocean Technologies Div., Office of Renewable Energy, U.S. Dept. of Energy (US)). pp. 1-9 of Proceedings of the AWEA national conference on windpower '88. American Wind Energy Assoc., Alexandria, VA (USA) (1988). (CONF-880916–: Windpower '88: 18. national conference of the American Wind Energy Association, Honolulu, HI (USA), 18-22 Sep 1988).

The United States Wind Energy Technology Research Program is described. It is directed toward establishing a technology base that will allow industry to develop cost-effective wind turbines as an energy supply alternative. Therefore the focus of its activities is on the improvement of technology to satisfy these needs and the transfer of this insight to American industry.

36880 The Sandia/DOE/USDA 34-meter-diameter vertical axis wind turbine test bed. Klimas, P.C. (Sandia National Labs., Albuquerque, NM (USA)). pp. 127-128 of Proceedings of the AWEA national conference on windpower '88. American Wind Energy Assoc., Alexandria, VA (USA) (1988). DOE Contract AC04-76DP00789. (CONF-880916–: Windpower '88: 18. national conference of the American Wind Energy Association, Honolulu, HI (USA), 18-22 Sep 1988).

Sandia National Laboratories (SNL) is currently operating its Department of Energy (DOE)-funded 34- M-Diameter Vertical Axis Wind Turbine (VAWT) Test Bed on a Department of Agriculture (USDA) site near Amarillo, Texas. This versatile VAWT, rated at 500 kW in a 12.4 m/s (28 mph) wind, has been designed to demonstrate aerodynamic, structural dynamic, and control strategies intended to improve the effectiveness of VAWT systems. An overview of this project is presented.

36881 Liquid crystals for surface shear stress visualization on wind turbine airfoils. Reda, D.C. (Sandia National Labs., Albuquerque, NM (USA)); Smith, R.W.; Bryant, T.C.; Schluter, L.L. pp. 156-165 of Proceedings of the AWEA national conference on windpower '88. American Wind Energy Assoc., Alexandria, VA (USA) (1988). (CONF-880916–: Windpower '88: 18. national conference of the American Wind Energy Association, Honolulu, HI (USA), 18-22 Sep 1988).

Experiments were conducted on the Sandia 17-m vertical axis wind turbine to test the liquid- crystal/surface-shear-stress visualization technique in field environments. A Sandia natural-laminar-flow airfoil served as the test surface. Initial feasibility experiments were conducted under high-tip-speed-ratio, high-Reynolds-number conditions, which resulted in low angle-of-attack, quasi- steady flow fields. Data acquisition was accomplished with a tower-mounted movie camera and 35 mm color film. Liquid crystal coatings sensitive only to surface shear stress, and insensitive to temperature changes for temperatures below 50°C, were utilized. Observations of coating color changes show the liquid crystal technique capable of visualizing surface shear stress distributions, including (by contrast) regions of separated flow, under field-test conditions.

36882 VAWT stochastic loads using a 3-D turbulence simulation. Homicz, G.F. (Sandia National Labs., Albuquerque, NM

(USA)). pp. 175-184 of Proceedings of the AWEA national conference on windpower '88. American Wind Energy Assoc., Alexandria, VA (USA) (1988). DOE Contract AC04-76DP00789. (CONF-880916–: Windpower '88: 18. national conference of the American Wind Energy Association, Honolulu, HI (USA), 18-22 Sep 1988).

The stochastic (i.e., random) aerodynamic loads created by atmospheric loads created by atmospheric turbulence are thought to be a primary cause of premature blade fatigue in Vertical-Axis Wind Turbines (VAWTs). This paper describes a computer program for the prediction of these stochastic loads, based on a full 3-D simulation of the turbulence field. Computed results using this model are compared with the deterministic (periodic) loads which occur in the absence of turbulence, and with the predictions of an earlier model which employed a 1-D simulation of the turbulence. The results show that not only are instantaneous loads significantly influenced by turbulence, but that load distribution averaged over numerous revolutions are affected as well. A particularly interesting finding is that, for the same mean wind speed, the average output power is altered by turbulence.

36883 **The HNEI/Kahua wind energy storage test facility.** Holst, B. (Hawaii Natural Energy Inst., Honolulu, HI (USA)); Neill, D.; Huang, H. pp. 490 of Proceedings of the AWEA national conference on windpower '88. American Wind Energy Assoc., Alexandria, VA (USA) (1988). (CONF-880916–: Windpower '88: 18. national conference of the American Wind Energy Association, Honolulu, HI (USA), 18-22 Sep 1988).

This paper reports on the development of a facility for the purpose of testing and evaluating energy storage technologies within a real and active load scenario. This paper describes the facility, discusses recent test projects, and outlines the proposed plans for future work.

36884 **Technical description of AVENU: A comprehensive computer software system for wind farm design.** Lissaman, P.B.S. (Dow Chemical Co., Midland, MI (USA). Hydrocarbons and Energy Research Lab.); Foster, D.R.; Hibbs, B.D.; Rumbaugh, J.H. pp. 403-412 of Proceedings of the AWEA national conference on windpower '88. American Wind Energy Assoc., Alexandria, VA (USA) (1988). (CONF-880916–: Windpower '88: 18. national conference of the American Wind Energy Association, Honolulu, HI (USA), 18-22 Sep 1988).

As the wind energy industry has matured, developers and operators of projects have required a more detailed and quantitative projection of wind farm performance characteristics. In the planning stages of wind projects, developers need wind flow patterns and array interactions to optimize turbine siting. This is especially significant when wind farms are planned for less windy, more rugged sites, or new units are being interspersed into existing arrays. Project financing organizations demand increased precision and confidence levels in energy and revenue projections, since wind projects must compete economically with other energy options. Once installed, the operations and maintenance groups need to predict and isolate problems so they can act effectively.

36885 **The wind lumps that bump a rotor.** Connell, J.R. (Pacific Northwest Lab., Richland, WA (USA)). pp. 452-461 of Proceedings of the AWEA national conference on windpower '88. American Wind Energy Assoc., Alexandria, VA (USA) (1988). DOE Contract AC06-76RL01830. (CONF-880916–: Windpower '88: 18. national conference of the American Wind Energy Association, Honolulu, HI (USA), 18-22 Sep 1988).

Wind turbines cannot get along without the wind and sometimes they have trouble getting along with it. At the core of the problem is the way turbine rotors interact with turbulence. At the core of the solution is an appreciation for and understanding of the features of turbulence. Turbulent wind is complex. To avoid this complexity when considering the effects of turbulence, it is characterized by statistics that leave most of us with a sense of turbulence being a random set of nearly featureless fluctuations of wind velocity distributed in space and time by some statistical rule. Yet the authors have personal experience that the wind is filled with eddies or gusts with shapes and sizes that produce a lumpiness to the flow of wind that is far from featureless and is not random in all aspects. The authors would not be concerned about the invisible shapes and sizes of turbulence eddies, and would more readily accept the usual statistical descriptions, if the authors could use the statistics to routinely predict the effect of turbulence in determining the aerodynamic forces on wind turbine rotors for most of the operating conditions of interest. There are two main reasons for wanting to know more about the structure of the turbulence eddies. One, the authors think it will help us know more about the important effects of turbulence. Two, the authors think it will help us better predict the variable extent of those effects in different conditions of atmosphere and terrain in which wind turbines will be operated.

36886 **Results of a detailed field measurement program to evaluate micrositing tools.** Simon, R.L. pp. 541-559 of Proceedings of the AWEA national conference on windpower '88. American Wind Energy Assoc., Alexandria, VA (USA) (1988). (CONF-880916–: Windpower '88: 18. national conference of the American Wind Energy Association, Honolulu, HI (USA), 18-22 Sep 1988).

An intensive field data collection program was conducted on a 130-hectare property in Altamont Pass, California, to support micrositing of a 50-unit wind turbine array and to evaluate several micrositing strategies (including computer modeling). These results are specific to this property; however, the concepts and results of this study can be successfully adapted to other properties. Several recommendations are made.

20 FOSSIL-FUELED POWER PLANTS

2001 Power Plants and Power Generation

Refer also to citation(s) 36934

36887 (CONF-900801–8) **Utilization of off-peak electric power to improve cycle efficiency during peak demand periods.** Jody, B.J.; Daniels, E.J. Argonne National Lab., IL (USA). 6 Apr 1990. 8p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract W-31109-ENG-38. From 25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990. Order Number DE90011162. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper describes a procedure to use off-peak power to produce ice, which could be melted during peak demand periods to produce a cold heat sink for condensation of the low-pressure steam turbine exhaust at lower temperatures, thereby allowing more expansion in the turbine, ore work output per pound of stem processed, and a higher efficiency. An analysis of this process has shown that substantial improvement in operating efficiency and net power output during peak demand periods can be achieved. This improvement will allow balancing of the peak and the off-peak demands and will reduce the need for expensive expansion of existing facilities to meet growing needs of the community. 6 figs.

36888 (DOE/MC/21023–2825-Vol.1) **Second-generation pressurized fluidized bed [PFB] combustion plant: Conceptual design and optimization of a second-generation PFB combustion plant, Phase 1, Task 1: Volume 1.** Robertson, A.; Garland, R.; Newby, R.; Rehmat, A.; Rubow, L. Foster Wheeler Development Corp., Livingston, NJ (USA). Sep 1989. 470p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-86MC21023. Order Number DE90000412. Available from NTIS, PC A20/MF A01 - OSTI; GPO Dep.

This three-volume report presents a conceptual design of a coal-fired second-generation pressurized fluidized bed (PFB) combustion plant and identifies its sensitivity to varying operating conditions and economic factors. Depending upon the conditions selected, the plant can achieve a 45-percent efficiency (based on the higher heating value of the coal used as fuel) and a cost of electricity at least 20 percent lower than that of a conventional pulverized-coal-fired plant with wet limestone, flue gas desulfurization. The proposed plant reaches these performance levels by integrating a coal pyrolyzer/carbonizer with a circulating pressurized fluidized bed combustor (CPFBC). Char produced by the carbonizer is burned in the CPFBC and the low-Btu fuel gas produced by the carbonizer is burned in a topping combustor to heat the CPFBC exhaust gas to 2100°F and higher before it enters the gas turbine. The carbonizer and CPFBC operate with lime-based

sorbents for in-situ sulfur capture at ≤1600°F. Components being developed for first-generation PFB plants (gas turbine inlet temperature ≤1600°F) protect the gas turbine from corrosion, erosion, and deposition. 120 figs., 115 tabs.

36889 (DOE/MC/21335–2823-Vol.1) **Performance analysis of a screenless (counter-current) Granular Bed Filter on a subpilot-scale PFBC [pressurized fluidized-bed combustor], Volume 1: Final report.** Wilson, K.B.; Haas, J.C. Combustion Power Co., Inc., Menlo Park, CA (USA). Oct 1989. 220p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-84MC21335. Order Number DE90000486. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The US Department of Energy sponsored this program to develop and test the Granular Bed Filter (GBF) as part of the overall program to develop coal-fired, pressurized fluidized-bed combustors to be used in combined-cycle power generating systems. In these systems a portion of the electricity is generated using a gas turbine driven by the high-temperature, high-pressure combustion gas. A hot gas cleanup train, such as the Granular Bed Filter, must be installed before the gas turbine to prevent erosion of turbine materials and deposition of particulate within the turbine. Meeting New Source Performance Standards (NSPS) with this filter is also required to eliminate need for post-turbine particulate removal. Furthermore, it has also been shown that alkali (sodium and potassium) in trace amounts can harm gas turbine materials. The GBF was evaluated for removal of these containments. The purpose of this work was to obtain information on the operational and economic feasibility of the Granular Bed Filter when applied to a pressurized fluidized-bed combustor (PFBC) as a high-temperature, high-pressure particle control device. In this program, experimental data was obtained on the design and operational life of critical components, an experimental sequence was conducted on a subpilot-scale GBF test module, and an update of a commercial-scale design was completed based on experimental data.

36890 Coatings for high temperature corrosion in aero and industrial gas turbines. Patnaik, P.C. (Orenda Div., Hawker Siddeley Canada Inc., Toronto, Ontario (CA)). pp. 37-62 of Surface modification technologies II. Sudarshan, T.S.; Bhat, D.G. The Metallurgical Society Inc., Warrendale, PA (USA) (1989). (CONF-8809211–: 2. international conference on surface modification technologies, Chicago, IL (USA), 25-28 Sep 1988).

Protective coatings are extensively used in aero gas turbine engines to combat high temperature corrosion, erosion and thermal fatigue damage. This paper considers the modes of coating degradation and possible solutions that are being offered by state of the art coating technologies. The evolution of turbine hot section materials from polycrystalline to directionally solidified and single crystal alloys along with increasing complexity in component design in aero gas turbine engines have led to the development of advanced overlay and thermal barrier coatings. These advanced coatings are reviewed critically with respect to their compatibility with a variety of nickel and cobalt based superalloy substrates.

36891 Recertification of a high pressure vessel using nondestructive evaluation techniques. Roach, D.P. (Sandia National Labs., Albuquerque, NM (USA)). pp. 193-202 of Life extension and assessment: Nuclear and fossil power-plant components. Jaske, C.E.; Shah, V.N.; Sinnappan, J.; Meligi, A.E.; Narayanan, T.V.; Bond, C.B. American Society of Mechanical Engineers, New York, NY (USA) (1988). (CONF-880661–: ASME pressure vessel and piping conference, Pittsburgh, PA (USA), 19-23 Jun 1988).

In an effort to meet both testing demands and budget constraints, the Structural Mechanics Lab at Sandia National Laboratories purchased a used high pressure vessel (working pressure 40 ksi). At the time this investigation began, the vessel had been out-of-service for ten years. This paper describes a series of nondestructive techniques (NDT) which were used to assess the fitness of the vessel and to recertify its original pressure rating. Dye penetrant and ultrasonic inspections and an overpressure test with acoustic emission monitoring were all used to assure the structural integrity of the vessel. The design and installation of a new sealing system, necessitated by the deterioration of the original system, is also presented. By combining the NDT evaluation process with a sealing system configured to suit experimental applications, it was possible to salvage the vessel for continued use. This resulted in a substantial savings of time and money versus the purchase of a new vessel with similar capabilities.

2002 Waste Management

Refer also to citation(s) 36706, 36707, 36888, 37041, 37149

36892 (ANL/ESD–7) **Spray-dryer flue-gas-cleaning systems handbook.** Huang, H. (Tennessee Univ., Knoxville, TN (USA). Dept. of Civil Engineering); Allen, J.W.; Livengood, C.D.; Davis, W.T.; Farber, P.S. Argonne National Lab., IL (USA). Energy Systems Div. Apr 1988. 195p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. Order Number DE90011272. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

Flue-gas cleaning systems based on spray drying are a recent development in pollution-control technology and have not been generally applied to combustion systems burning high-sulfur coal. However, Argonne National Laboratory has been operating a spray-dryer/fabric-filter system for the control of SO_2 and particulate matter from a 20 MW (equivalent) stoker-fired boiler for about seven years, using coals with sulfur contents as high as 4.5%. Information acquired during that time, which could be useful to designers, builders, and operators of such systems, is presented. A summary of important equipment and process design considerations, a discussion of economic criteria (with guidance for making preliminary cost estimates), a review of operating and maintenance experiences at Argonne, and suggestions for structuring and carrying out the procurement of such a system are also included. In addition, recent research, such as sorbent activity enhancement and the combined control of SO_2 and NO_x, are briefly reviewed. 80 refs., 24 figs., 17 tabs.

36893 (ANL/ESD/TM–6) **User's guide for SDIS [Spray-Dryer Information System]: A personal computer code for the design and evaluation of spray-dryer flue-gas-cleaning systems.** Anderson, J.L. Argonne National Lab., IL (USA). Energy Systems Div. Mar 1989. 40p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. Order Number DE90011257. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report documents a menu-driven personal computer system, the Spray-Dryer Information System (SDIS), developed for the design and evaluation of spray-dryer flue-gas-cleaning systems. The code is modular in design and includes subroutines that provide the user with interactive input screens, particulate-control design and evaluation models, and input/output file-management capabilities. SDIS is written in FORTRAN and was designed specifically for use on an IBM (or compatible) personal computer. 1 ref.

36894 (ANL/ESD/TM–7-Vol.2) **Combined nitrogen oxides/sulfur dioxide control in dry scrubber systems: Volume 2, Evaluation of additives and process modifications: Appendixes.** Harkness, J.B.L.; Gorski, A.J.; Huang, H.S. Argonne National Lab., IL (USA). Energy Systems Div. Feb 1989. 202p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. Order Number DE90011798. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

ANL is investigating alternative control concepts involving modification of existing flue-gas-cleaning processes and addition of sorbents, with the objective of achieving simultaneous removal of oxides of nitrogen (NO_x) and sulfur dioxide (SO_2). Laboratory research with a fixed-bed reactor and a spray-dryer/fabric-filter system has been paralleled by field tests at ANL's 20-MW (electric equivalent) dry scrubber. The first volume of this report describes the experimental apparatuses, procedures, design, and results in terms of the effects additives and principal process variables had on NO_x and SO_2 removals. This second volume presents statistical analyses of the experimental results, prepared using the DESIGN-EASE® software on an IBM/XT personal computer.

36895 (ANL/ESD/TM–8) **Combined nitrogen oxides/sulfur dioxide control in a spray-dryer/fabric-filter system: Summary report for the Field Research Program.** Brown, K.A. (ed.); Huang, H.; Allen, J.W.; Livengood, C.D. Argonne National Lab., IL (USA). Energy Systems Div. Nov 1988. 35p. Sponsored by U.S.

DOE Fossil Energy. DOE Contract W-31109-ENG-38. Order Number DE90011274. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A combination of modified process conditions and addition of caustic soda to a lime-based spray-dryer system (20-MW electric equivalent) was evaluated for its value in promoting combined NO_x/SO_2 removal from flue gas resulting from the combustion of high-sulfur coal. Two test series, each about one month in duration, were carried out at Argonne National Laboratory (ANL) in 1986 and 1988. Spray-dryer outlet temperature was identified as a key factor with NO_x removal becoming significant above about 180°F and gradually increasing up to the maximum temperature investigated (210°F). No upper limit on removal with increasing temperature was observed. Removal of NO_x was strongly proportional to baghouse filter-cake thickness; nearly all NO_x removal occurred in the baghouse, with a small net production of NO_2 (<15 ppM). The NO_x removal was also proportional to the SO_2NO_x ratio, with little NO_x removal observed at SO_2/NO_x ratios less than 2:1. Caustic soda addition improved NO_x removal, at least partially through creation of a more porous and reactive filter cake. Steady-state removals of 70% for SO_2 and 35% for NO_x were easily attained. 10 refs., 14 figs., 4 tabs.

36896 (DOE/PC/88852–T2) **Physical flow model study of the Ohio Power Company's 12-MW duct injection test facility in Beverly, Ohio: Topical report 10A.** United Engineers and Constructors, Inc., Denver, CO (USA). Stearns-Roger Div.; Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div. Jan 1990. 97p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88852. Order Number DE90011144. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This is a three-year program to advance the state of the art of duct injection technology in existing coal-fired power plants to reduce SO_2 emissions. Tasks include: duct configuration survey; enhanced sorbent utilization; fundamental investigations of duct and electrostatic precipitator (ESP) phenomena; scale-up tests and supporting research; and prototype development, for which UE&C is the prime contractor. The Babcock and Wilcox (B&W) Alliance (Ohio) Research Center's (ARC) Heat Transfer & Fluid Mechanics Section has two major tasks that support UE&C's development activity. The first is to perform a physical flow model study of the existing test duct located at the Ohio Power Company's Muskingum River Station Unit No. 5 in Beverly, Ohio. The second is to develop a second-generation mathematical model that describes the performance of the duct injection process and the collection of the fly ash/spent-sorbent mixture in an ESP. This report will cover only the physical flow modeling. 14 figs., 4 tabs.

36897 (DOE/PC/88860–T1) **Simultaneous NO_x/SO_2 removal by the dry injection of lime-urea hydrate: Final report.** Muzio, L.J.; Himes, R.M.; Thompson, R.E. Fossil Energy Research Corp., Laguna Hills, CA (USA). Mar 1990. 227p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88860. (FR–7010-1). Order Number DE90009566. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

The attractiveness of dry SO_2 removal processes may be enhanced if NO_x could be removed along with SO_2 using a single dry sorbent. A modified hydrate was developed that simultaneously removes SO_2 and NO_x. The hydrate is prepared by hydrating quicklime, CaO, with a urea water solution. Pilot-scale results of injecting this single dry lime-urea hydrate powder into a furnace are presented. An economic assessment was also conducted in order to ascertain the cost benefit derived from the simultaneous removal of SO_2 and NO_x with a single sorbent. The economics focused on the process as a retrofit technique on existing units. In order to provide a comparative basis with alternative technologies, the sensitivity of the levelized costs for the lime-urea hydrate were examined as a function of unite size; coal sulfur; capacity factor; and plant remaining life. These costs were normalized on a dollar per ton pollutant removed to facilitate a comparative assessment with alternative SO_2 and NO_x reduction technologies. Alternative technologies examined were comprised of combinations of wet flue gas desulfurization (FGD) and furnace sorbent injection (FSI) for SO_2 reduction; and selective catalytic reduction (SCR), low-NO_x burners (LNB), and Thermal DeNO_x for NO_x reductions. 38 refs., 50 figs., 32 tabs.

36898 (DOE/PC/88874–T8) **Theoretical approach for enhanced mass transfer effects in-duct flue gas desulfurization processes: Quarterly report No. 7, January 1, 1990–March 31, 1990.** Acurex Corp., Research Triangle Park, NC (USA). Environmental Systems Div.; Texas Univ., Austin, TX (USA). Dept. of Chemical Engineering. 25 Apr 1990. 50p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88874. Order Number DE90011035. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

During this reporting period, bench- and pilot-scale experiments have been concluded to measure mass transfer and kinetic rates at simulated duct injection conditions. Section 2 describes the tank reactor test results. Present work is focused on running the slurry absorption model for solution compositions which are representative of the tests performed in the stirred tank reactor. The slurry absorption model has been run successfully to simulate most of the clear solution experiments. Section 3 presents the results of a special study investigating the use of Epsom Salt (magnesium sulfate heptahydrate, $MgSO_4 \cdot 7H_2O$) as an additive for in-duct dry injection to reduce the amount of water needed for humidification. Industrial grade Epsom Salt was injected into a 50-cfm pilot plant at ~3.4 lb/h. Section 4 summarizes the status of slaking modification tests. The present study focuses on an evaluation of techniques for the production of a fine particulate $Ca(OH)_2$ during slaking. Section 5 reports on differential reactor (Task 4) tests. The reactor has been modified to allow contact of solids containing varying amounts of surface water with humidified flue gas for 10–120 s. Preliminary gas and wet solids experiments have been performed using lime/flyash mixtures containing 5–40 percent initial free moisture. 3 refs., 14 figs., 10 tabs.

36899 (DOE/PC/91021–T9) **Flue gas cleanup technology utilizing energetic electrons: Final report, May 6, 1986–March 5, 1989.** Finney, W.C. (ed.); Davis, R.H. Florida State Univ., Tallahassee, FL (USA). Dept. of Physics. [1989]. 396p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-86PC91021. Order Number DE90008836. Available from NTIS, PC A14/MF A01 - OSTI; GPO Dep.

The objective of this project is to conduct experiments on electrical charging of aerosol particles using electron beam ionization in order to assess and optimize a precharging system for cleanup of flue gas from coal-fired power plants. Tasks include: maximization of the overall efficiency of the electron beam precharger and collector system as characterized by the penetration and the effective migration velocity. Operate with negative and positive working ions on PSL particles for light loading and hydral particles for heavier loading; maximization of the performance of the Mark II precharger in terms of the effective migration velocity by varying the voltage on the precharger electrodes. Use negative working ions; measure the performance for variation of the electron beam energy and current; empirically establish a relationship between performance and total power consumption; measure the charge acquired by individual particles in the precharger; simulate a high resistivity dust layer on the electrodes; measure the precharger performance for heavy dust loading; try pulsed energization of electron beam precharger; test performance with polydisperse particles in the model aerosol to establish efficiency over a range of particle sizes; Provide a preliminary design of a scaled up precharger for tests on the slip stream of a coal burning power plant; complete the free electron charging experiments using DES (di-2-ethylhexyl) (sebecate) particles and dry nitrogen; perform free electron charging experiments using argon; determine free electron charging performance for humidity values and oxygen concentration found in flue gas ducts; model construction of the free electron charging under ideal conditions; design high temperature free electron charging chamber; determine the effect of CO_2 in concentrations typical of flue gas on free electron charging. 28 refs., 88 figs., 19 tabs.

36900 (LBL–28869) **Computer modeling of the chemistry of aqueous scrubber systems.** Littlejohn, D.; Chang, Shih-Ger. Lawrence Berkeley Lab., CA (USA). Apr 1990. 8p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC03-76SF00098. (CONF-900802–2: 200. American Chemical Society national meeting,

Washington, DC (USA), 26-31 Aug 1990). Order Number DE90011226. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The chemistry occurring in aqueous flue gas scrubbing solutions can be quite complicated, due to the large number of chemical species present and the many physical processes involved. These include gas absorption into solution, gas and solution kinetics involving both nitrogen oxides and sulfur oxides, oxidation and hydrolysis reactions in solution, and liquid-solid interactions. Simple models that neglect the solution kinetics which can occur in scrubbers cannot be expected to accurately model aqueous-based scrubber chemistry. We have developed a computer model which incorporates the aqueous solution kinetics of nitrogen oxyanions, sulfur oxyanions, nitrogen-sulfur compounds, and other species. The model can be adapted to predict the chemistry in a wide range of aqueous-based scrubber systems. It can be used to study the effect of changes in the operating conditions of the scrubbers. The results of the model can be compared with experimental observations to determine how well the chemistry of the solutions is understood. 9 refs., 2 figs., 1 tab.

2004 Health and Safety

Refer also to citation(s) 36943

2005 Environmental Aspects

Refer also to citation(s) 37149, 37562, 37571

36901 (ORNL/TM–11301) **Assessing the potential environmental impacts of proposed rules affecting future electric power generation in the United States.** Hunsaker, D.B. Jr. (Oak Ridge National Lab., TN (USA)); McLean, R.B.; Cada, G.F.; Liebsch, E.J.; Graham, R.L.; Garten, C.T.; Hunsaker, C.T.; Campbell, A.W.; Marland, G.; Miller, R.L. Oak Ridge National Lab., TN (USA). Feb 1990. 64p. Sponsored by Federal Energy Regulatory Commission. DOE Contract AC05-84OR21400. Order Number DE90012745. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

In 1988, the Federal Energy Regulatory Commission (FERC) began development of two rules with the potential to affect future electric power generation in the United States: one would prescribe minimum conditions under which competitive bidding may be used to establish rates for purchasing electrical power, and the other would reduce FERC regulations that interfere with the ability of independent power producers to produce and sell power. These rules, which would be issued simultaneously, could alter the fuel mix that supplies future electrical generating capacity projected by the utilities, which in turn could affect environmental impacts of producing electric power. The rules must be issued in accordance with the National Environmental Policy Act (NEPA). This report has been prepared to evaluate the potential for environmental effects from future changes in fuel mix that could result from issuing the rules, and thus, in accordance with NEPA, to help the FERC determine if the rules would result in significant impacts on the human environment. Based on the results of this work, the FERC prepared and issued draft and final environmental impact statements (EISs) in 1988 while formally proposing the rules. As of December 1989, the rules had not yet been finalized. 19 refs., 7 figs., 13 tabs.

2006 Economic, Industrial, and Business Aspects

Refer also to citation(s) 36888

2007 Legislation and Regulations

Refer also to citation(s) 36709

21 NUCLEAR POWER PLANTS

36902 (DOE/OSTI–8200-R53) **Nuclear reactors built, being built, or planned: 1989.** USDOE Office of Scientific and Technical Information, Oak Ridge, TN (USA). Jun 1990. 77p. Sponsored by U.S. DOE Nuclear Energy. Order Number DE90008285. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

Nuclear Reactors Built, Being Built, or Planned contains unclassified information about facilities built, being built, or planned in the United States for domestic use or export as of December 31, 1989. The Office of Scientific and Technical Information, US Department of Energy, gathers this information annually from Washington headquarters and field offices of DOE, from the US Nuclear Regulatory Commission, from the US reactor manufacturers who are the principal nuclear contractors for foreign reactor locations, from US and foreign embassies, and from foreign governmental nuclear departments. Information is presented in five parts, each of which is categorized by primary function or purpose: civilian, production, military, export, and critical assembly facilities.

36903 (DOE/OSTI–8200-R53-Suppl.) **Nuclear reactors built, being built, or planned: 1989: Supplement.** USDOE Office of Scientific and Technical Information, Oak Ridge, TN (USA). [1990]. 4p. Sponsored by U.S. DOE Nuclear Energy. Order Number DE90008254. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

These maps provide a nuclear generating unit profile as of December 31, 1989, and are part of the publication Nuclear Reactors Built, Being Built, or Planners. (FI).

2101 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled

Refer also to citation(s) 36944, 36976, 36977, 36979, 36985, 37234, 37392

36904 (DOE/ID–10278) **Technical support for the EPRI [Electric Power Research Institute] debris coolability requirement for advanced light water reactors: Advanced Reactor Severe Accident Program.** EG and G Idaho, Inc., Idaho Falls, ID (USA); Fauske and Associates, Inc., Burr Ridge, IL (USA). Mar 1990. 74p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (MISC–90057). Order Number DE90013095. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

The Electric Power Research Institute (EPRI) advanced light water reactor (ALWR) design requirement for cavity sizing to promote long-term core debris coolability specifies that the reactor containment be arranged to afford a floor area for potential core debris spreading of at least 0.02 square meters per thermal megawatt of reactor power. This requirement has substantial experimental and analytical support as a sufficient basis to ensure long-term debris coolability. A logical framework and presentation of such support is provided in this document. The evidence as presented demonstrates that, following vessel failure, core debris in the cavity would consist of a mixture of fragments and a relatively continuous, but porous and cracked, phase that would be distributed relatively uniformly over the area that would be available per the requirement. Considering pertinent operative heat transfer phenomena, it is also demonstrated that the heat removal rate from core debris in this configuration would be sufficient to ensure debris coolability in the reactor cavity, even when the cavity is flooded after vessel failure. 29 refs., 6 figs., 8 tabs.

36905 (NUREG–1372) **Regulatory analysis for the resolution of generic issue C—8, main steam isolation valve leakage and LCS [leakage control system] failure.** Graves, C.C. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution. Jun 1990. 22p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO; OSTI; INIS.

Generic Issue C-8 deals with staff concerns about public risk because of the incidence of leak test failures reported for main steam isolation valves (MSIVs) at boiling water reactors and the limitations of the leakage control systems (LCSs) for mitigating the consequences of leakage from these valves. If the MSIV leakage is greatly in excess of the allowable value in the technical specifications, the LCS would be unavailable because of design limitations. The issue was initiated in 1983 to assess (1) the causes of MSIV leakage failures, (2) the effectiveness of the LCS and alternative mitigation paths, and (3) the need for additional

regulatory action to reduce public risk. This report presents the regulatory analysis for Generic Issue C-8 and concludes that no new regulatory requirements are warranted.

36906 (NUREG/CR–4667-Vol.8) **Environmentally assisted cracking in light water reactors: Semiannual report, October 1988–March 1989: Volume 8.** Kassner, T.F. (Argonne National Lab., IL (USA)); Park, J.Y.; Ruther, W.E.; Shack, W.J.; Diercks, D.R.; Soppet, W.K. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Argonne National Lab., IL (USA). Jun 1990. 39p. Sponsored by Nuclear Regulatory Commission. DOE Contract W-31109-ENG-38. (ANL–90/4-Vol.8). Available from NTIS, PC A03/MF A01 - GPO; OSTI; INIS.

This report summarizes work performed by Argonne National Laboratory on environmentally assisted cracking in light water reactors during the six months from October 1988 to March 1989. The effects of load ratio on stress corrosion cracking (SCC) of Types 316NG, 304, and CF-3M cast stainless steels (SSs) were investigated by fracture-mechanics crack-growth-rate (CGR) tests in high-temperature water. The influence of organic impurities on the SCC of Type 316NG SS was also investigated in long-term CGR tests. Tests to determine the susceptibility of 4-in.-diameter Types 316NG and 304 SS pipe weldments to SCC in simulated BWR environments have been conducted. The influence of carbonate at concentrations between 0.1 and 3300 ppM on the SCC behavior of sensitized Type 304 SS in deoxygenated water (<5 ppB) was determined in constant-extension-rate tensile tests. Fatigue tests were conducted on Type 316NG SS in air and BWR environments to assess the degree of conservatism in the ASME Code Section 3 fatigue design curves. CGR tests are being conducted to determine susceptibility of A533-Gr B low-alloy ferritic steel to SCC in simulated BWR environments. 39 refs., 20 figs., 7 tabs.

36907 (NUREG/CR–4816) **PR-EDB: Power Reactor Embrittlement Data Base, version 1: Program description.** Stallmann, F.W. (Oak Ridge National Lab., TN (USA)); Kam, F.B.K.; Taylor, B.J. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Oak Ridge National Lab., TN (USA). Jun 1990. 85p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/TM–10328). Available from NTIS, PC A06/MF A01 - GPO; OSTI; INIS.

Data concerning radiation embrittlement of pressure vessel steels in commercial power reactors have been collected form available surveillance reports. The purpose of this NRC-sponsored program is to provide the technical bases for voluntary consensus standards, regulatory guides, standard review plans, and codes. The data can also be used for the exploration and verification of embrittlement prediction models. The data files are given in dBASE 3 Plus format and can be accessed with any personal computer using the DOS operating system. Menu-driven software is provided for easy access to the data including curve fitting and plotting facilities. This software has drastically reduced the time and effort for data processing and evaluation compared to previous data bases. The current compilation of the Power Reactor Embrittlement Data base (PR-EDB, version 1) contains results from surveillance capsule reports of 78 reactors with 381 data points from 110 different irradiated base materials (plates and forgings) and 161 data points from 79 different welds. Results from heat-affected-zone materials are also listed. Electric Power Research Institute (EPRI), reactor vendors, and utilities are in the process of providing back-up quality assurance checks of the PR-EDB and will be supplementing the data base with additional data and documentation. 2 figs., 28 tabs.

2102 Power Reactors, Nonbreeding, Light-Water Moderated, Nonboiling Water Cooled

Refer also to citation(s) 36904, 36907, 36944, 36964, 36965, 36966, 36968, 36969, 36975, 36976, 36977, 36979, 36981, 36982, 36983, 36984, 36985, 36991, 36993, 36994, 37392, 37940

36908 (CEA-DAS–625) **Objectives, specification and elaboration of technical scenarios for emergency drills involving a French PWR.** Duco, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Aug 1989. 13p. (CONF-8906137–: Joint NEA/CEC workshop on technical aspects of emergency planning, Brussels (Belgium), 27-29 Jun 1989). Order Number DE90500635. Available from NTIS (US Sales Only), PC A03/MF A01.

All safety measures taken during the design, the construction and the operation of a nuclear power plant decrease to an extremely low level the probability of an accident with unacceptable consequences for the public. Nevertheless, for the case such an accident should be initiated, emergency plans have been elaborated: the on-site emergency plan to protect the plant personnel, terminate the accident and mitigate the consequences; the short-term and longer-term off-side emergency plans to protect the public and organise the return to acceptable living conditions. The appropriateness and preparedness of such plans have to be checked regularly by means of drills, which may be restricted to technical aspects concerning the nuclear units, or involve all actors, i.e. the utility, all the branches of the administration concerned and a media simulation. Some aspects of the choice of goals and preparation of drills are presented and illustrated by the national EPAULE exercice in 1987. Technically speaking, the drills have proved the validity of the current organization and evidenced its operability: uncertainties remain as regards the actual vs expected behavior of the population, due to emotional aspects linked to the lack of direct perception of the degree of danger and to the information received in an actual nuclear emergency.

36909 (CEA-DAS–627) **Heat transfer in reactor cavity during core-concrete interaction.** Adroguer, B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire); Cenerino, G. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Aug 1989. 10p. (CONF-890546–: ICHMT international seminar on fission product transport processes in reactor accidents, Dubrovnik (Yugoslavia), 22-26 May 1989). Order Number DE90500636. Available from NTIS (US Sales Only), PC A02/MF A01.

In the unlikely event of a severe accident in a nuclear power plant, the core may melt through the vessel and slump into the concrete reactor cavity. The hot mixture of the core material called corium interacts thermally with the concrete basemat. The WECHSL code, developed at K.f.K. Karlsruhe in Germany is used at the Protection and Nuclear Safety Institute (I.P.S.N.) of CEA to compute this molten corium concrete interaction (MCCI). Some uncertainties remain in the partition of heat from the corium between the basemat and the upper surrounding structures in the cavity where the thermal conditions are not computer. The CALTHER code, under development to perform a more mechanistic evaluation of the upward heat flux has been linked to WECHSL-MOD2 code. This new version enables the modelling of the feedback effects from the conditions in the cavity to the MCCI and the computation of the fraction of upward flux directly added to the cavity atmosphere. The present status is given in the paper. Preliminary calculations of the reactor case for silicate and limestone common sand (L.C.S.) concretes are presented. Significant effects are found on concrete erosion, gases release and temperature of the upper part of corium, particularly for L.C.S. concrete.

36910 (CEA-DAS–634) **Failure of inconel X-750 bolts of internals of the CHOOZ-A nuclear power plant.** Olivera, J.J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire); Pierrey, J.L.; Le Naour, F.; Gilbon, D.; Cauvin, R. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Aug 1989. 19p. (CONF-8908236–: 4. International Symposium on Environmental Degradation of Materials in Nuclear Power Systems Water Reactors, Jekill Island GA, U (USA), 6-10 Aug 1989). Order Number DE90500637. Available from NTIS (US Sales Only), PC A03/MF A01.

After 100,000 hours of operation, during the 1984/85 routine shutdown, several bolt heads of the core barrel joint were found separated from their shanks inside the vessel of the first French pressurized water reactor (CHOOZ A - 305 MWe). Examination of

these Inconel X-750 bolts showed that rupture resulted from intergranular stress corrosion cracking (IGSCC). All the bolts were replaced by new ones, geometrically identical and made from the same material but with a new heat treatment in order to be more IGSCC resistant. In this paper we present a comparative metallurgical study of a prior unirradiated bolt and a new one. A particular and semicontinuous intergranular precipitation of $M_{23}C_6$ carbides and a homogeneous distribution of the thin γ' precipitates were observed in the most IGSCC resistant material. In order to get a better insight into the failure phenomena, mechanical tests and microstructural examinations (tensile tests, fractography, microhardness, metallography and TEM) were also performed on the previous irradiated bolts having about 10^5 hours of operation. Microstructural modifications and mechanical properties evolution were observed as a consequence of a PWR environment corresponding to a low service temperature ($\approx 275^0$C) and a very low irradiation dose (about 0.1 dpa).

36911 (CONF-900814–1) **Parameter and fluence-rate covariances in lepricon.** Maerker, R.E. Oak Ridge National Lab., TN (USA). [1990]. 8p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From 7. ASTM-EURATOM symposium on reactor dosimetry; Strasbourg (France); 27-31 Aug 1990. Order Number DE90009855. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The LEPRICON code system is now available from the Radiation Shielding Information Center at ORNL as PSR-277. The system consists of modules that involve both the calculation of neutron fluence rates through PWR pressure vessels and the adjustment of these fluence rates with reduced uncertainties based on surveillance dosimetry. This paper describes in detail the manner in which important parameter uncertainties are partitioned and quantified as part of the input to the adjustment procedure, and to what degree they are applicable to all reactor designs. 7 refs., 1 fig., 1 tab.

36912 (CONF-900814–2) **Analysis of the VENUS-3 experiments.** Maerker, R.E. (Oak Ridge National Lab., TN (USA)); D'hondt, P.; Leenders, L.; Fabry, A. Oak Ridge National Lab., TN (USA). [1990]. 8p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From 7. ASTM-EURATOM symposium on reactor dosimetry; Strasbourg (France); 27-31 Aug 1990. Order Number DE90010708. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The results of applying a hybrid superposition-synthesis calculational method to a mockup of a three-dimensional geometry involving a partial length shield assembly at the VENUS-3 facility in Mol, Belgium, are described. Comparisons of transport calculations using the method and many measurements involving nickel, indium, and aluminum dosimeters indicate agreement usually to within measurement uncertainties estimated at around 5%, if effects of inaccuracies in the dosimeter cross sections are minimized and proper orientation of the coordinate system used in the synthesis procedure is observed. These conclusions suggest a solution to the problem of predicting pressure vessel fluence in reactors modified by these partial-length shield assemblies may already exist. 7 refs., 2 figs., 1 tab.

2103 Power Reactors, Nonbreeding, Graphite Moderated

Refer also to citation(s) 37025

2104 Power Reactors, Nonbreeding, Otherwise Moderated or Unmoderated

36913 (INFO–0253-1) **Microcomputer based program for predicting heat transfer under reactor accident conditions. Volume I: Text.** Cheng, S.C. (Ottawa Univ., ON (Canada)); Groeneveld, D.C.; Leung, L.K.H.; Wong, Y.L.; Nguyen, C. Atomic Energy Control Board, Ottawa, ON (Canada). Jul 1987. 95p. Project 86.1.19. Order Number DE90630375. Available from NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

In executable FORTRAN V on IBM-PC AT or XT with a Math Co-processor.

A microcomputer based program called Heat Transfer Prediction Software (HTPS) has been developed. It calculates the heat transfer for the tube and bundle geometries for steady state and transient conditions. This program provides the best estimates of the hot pin temperatures during slow transients for 37- and 28-element CANDU type fuel bundles. The program is designed for an IBM-PC AT/XT (or IBM-PC compatible computer) equipped with a Math Co-processor. The following input parameters are required: pressure, mass flux, hydraulic diameter, and quality. For the steady state case, the critical heat flux (CHF), critical heat flux temperature, minimum film boiling temperature, and minimum film boiling heat flux are the primary outputs. With either the surface heat flux or wall temperature specified, the program determines the heat transfer regime and calculates the surface heat flux, wall temperatures and heat transfer coefficient. For the slow transient case, the pressure, mass flux, quality, and volumetric heat generation rate are the time dependent input parameters required to calculate the hot pin sheath temperatures and surface heat fluxes. A simple routine for generating properties has been developed for light water to support the above program. It contains correlations that have been verified for pressures ranging from 0.6kPa to 30 MPa, and temperatures up to 1100 degrees Celcius. The thermodynamic and transport properties that can be generated from this routine are: density, specific volume, enthalpy, specific heat capacity, conductivity, viscosity, surface tension and Prandtl number for saturated liquid, saturated vapour, subcooled liquid for superheated vapour. A software for predicting flow regime has also been developed. It determines the flow pattern at specific flow conditions, and provides a correction factor for calculating the CHF during partially stratified horizontal flow.

2105 Power Reactors, Breeding

Refer also to citation(s) 36937, 36938, 36941, 36946, 36953, 36955, 36956, 36957, 36958, 36959, 36960, 36961, 36962, 36963, 36987, 36989, 36996

36914 (BNL-NUREG–44501) **Simplified analysis of PRISM RVACS [Reactor Vessel Auxiliary Cooling System] performance without liner spill-over.** Van Tuyle, G.J. Brookhaven National Lab., Upton, NY (USA). [1990]. 9p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (CONF-900804–13: International topical meeting on fast reactor safety, Snowbird, UT (USA), 12-16 Aug 1990). Order Number DE90010644. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Simplified analysis of the performance of the PRISM RVACS decay heat removal system under off-normal conditions, i.e., without the liner spill-over, is described. Without the spilling of hot-pool sodium over the liner and the resultant down-flow along the inside of the reactor vessel wall, the RVACS system performance becomes dominated by the radial heat condition and radiation. Simple estimates of the resulting heat conduction and radiation processes support GE's contention that the RVACS performance is not severely impacted by the absence of spillover, and can improve significantly if sodium has leaked into the region between the reactor and containment vessels. 7 refs.

36915 (CONF-900804–1) **Forced-to-natural convection transition tests in parallel simulated liquid metal reactor fuel assemblies.** Levin, A.E. (Georgia Inst. of Tech., Atlanta, GA (USA)); Montgomery, B.H. Oak Ridge National Lab., TN (USA). [1990]. 4p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90004929. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The Thermal-Hydraulic Out of Reactor Safety (THORS) Program at Oak Ridge National Laboratory (ORNL) had as its objective the testing of simulated, electrically heated liquid metal reactor (LMR) fuel assemblies in an engineering-scale, sodium loop. Between 1971 and 1985, the THORS Program operated 11 simulated fuel bundles in conditions covering a wide range of normal and off-normal conditions. The last test series in the Program, THORS-SHRS Assembly 1, employed two parallel, 19-pin, full-length,

simulated fuel assemblies of a design consistent with the large LMR (Large Scale Prototype Breeder – LSPB) under development at that time. These bundles were installed in the THORS Facility, allowing single- and parallel-bundle testing in thermal-hydraulic conditions up to and including sodium boiling and dryout. As the name SHRS (Shutdown Heat Removal System) implies, a major objective of the program was testing under conditions expected during low-power reactor operation, including low-flow forced convection, natural convection, and forced-to-natural convection transition at various powers. The THORS-SHRS Assembly 1 experimental program was divided up into four phases. Phase 1 included preliminary and shakedown tests, including the collection of baseline steady-state thermal-hydraulic data. Phase 2 comprised natural convection testing. Forced convection testing was conducted in Phase 3. The final phase of testing included forced-to-natural convection transition tests. Phases 1, 2, and 3 have been discussed in previous papers. The fourth phase is described in this paper. 3 refs., 2 figs.

36916 (CONF-900804–3) **Tomographic imaging of severely disrupted fuel assemblies tested in TREAT.** Morman, J.A.; Froehle, P.H.; Holland, J.W.; Bennett, J.D. Argonne National Lab., IL (USA). [1990]. 11p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90010087. Available from NTIS, PC A03/MF A01; OSTI; INIS.

A series of CT codes is under development in the Reactor Analysis and Safety Division of Argonne National Laboratory for use as a post-test examination tool to analyze segments of the final fuel-bundle configuration of TREAT tests. This paper presents the results of CT analysis for fuel assemblies using neutron radiography. Fuel relocation following overpower transients in the TREAT reactor is examined for sections of the assemblies, and results are compared to metallographic sections. Further improvements are expected to increase the use and reliability of CT analysis as a standard post-test examination tool.

36917 (CONF-900804–6) **Real-time LMR control parameter generation using advanced adaptive synthesis.** King, R.W.; Mott, J.E. Argonne National Lab., Idaho Falls, ID (USA). [1990]. 15p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90010138. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The reactor "delta T", the difference between the average core inlet and outlet temperatures, for the liquid-sodium-cooled Experimental Breeder Reactor 2 is empirically synthesized in real time from, a multitude of examples of past reactor operation. The real-time empirical synthesis is based on reactor operation. The real-time empirical synthesis is based on system state analysis (SSA) technology embodied in software on the EBR 2 data acquisition computer. Before the real-time system is put into operation, a selection of reactor plant measurements is made which is predictable over long periods encompassing plant shutdowns, core reconfigurations, core load changes, and plant startups. A serial data link to a personal computer containing SSA software allows the rapid verification of the predictability of these plant measurements via graphical means. After the selection is made, the real-time synthesis provides a fault-tolerant estimate of the reactor delta T accurate to +/−1%. 5 refs., 7 figs.

36918 (CONF-900804–7) **Analysis of metal fuel transient overpower experiments with the SAS4A accident analysis code.** Tentner, A.M.; Kalimullah; Miles, K.J. Argonne National Lab., IL (USA). [1990]. 18p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90010059. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The results of the SAS4A analysis of the M7 TREAT Metal fuel experiment are presented. New models incorporated in the metal fuel version of SAS4A are described. The computational results are compared with the experimental observations and this comparison is used in the interpretation of physical phenomena. This analysis was performed using the integrated metal fuel SAS4A version and covers a wide range of events, providing an increased degree of confidence in the SAS4A metal fuel accident analysis capabilities.

36919 (CONF-900804–8) **Consequences of metallic fuel-cladding liquid phase attack during over-temperature transient on fuel element lifetime.** Lahm, C.E.; Koenig, J.F.; Seidel, B.R. Argonne National Lab., Idaho Falls, ID (USA). [1990]. 6p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90010055. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Metallic fuel elements irradiated in EBR-II at temperatures significantly higher than design, causing liquid phase attack of the cladding, were subsequently irradiated at normal operating temperatures to first breach. The fuel element lifetime was compared to that for elements not subjected to the over-temperature transient and found to be equivalent. 1 ref., 3 figs.

36920 (CONF-900804–9) **Fuel/cladding compatibility in irradiated metallic fuel pins at elevated temperatures.** Tsai, Hanchung. Argonne National Lab., IL (USA). Apr 1990. 12p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90010129. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Over fifty fuel/cladding compatibility tests on irradiated metallic fuel specimens have been conducted in an in-cell facility at elevated temperatures. At temperatures below 700–725°C, no fuel/cladding interaction was noted in tests up to 7 h. Liquid-phase cladding penetration occurred in some of the tests at temperatures greater than 725–750°C. The effective rates of liquid- phase cladding penetration of six different fuel/cladding combinations during 1-h testing are reported. After the initial liquefaction at the fuel/cladding interface, which may be affected by the solid-state diffusional interaction during the steady-state irradiation, the rate of further cladding penetration stays constant or decreases with time. There was no runaway cladding penetration in the latter part of a heating cycle.

36921 (CONF-900804–10) **Modeling developments for the SAS4A and SASSYS computer codes.** Cahalan, J.E.; Wei, T.Y.C. Argonne National Lab., IL (USA). [1990]. 11p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90010056. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The SAS4A and SASSYS computer codes are being developed at Argonne National Laboratory for transient analysis of liquid metal cooled reactors. The SAS4A code is designed to analyse severe loss-of-coolant flow and overpower accidents involving coolant boiling, Cladding failures, and fuel melting and relocation. Recent SAS4A modeling developments include extension of the coolant boiling model to treat sudden fission gas release upon pin failure, expansion of the DEFORM fuel behavior model to handle advanced cladding materials and metallic fuel, and addition of metallic fuel modeling capability to the PINACLE and LEVITATE fuel relocation models. The SASSYS code is intended for the analysis of operational and beyond-design-basis transients, and provides a detailed transient thermal and hydraulic simulation of the core, the primary and secondary coolant circuits, and the balance-of-plant, in addition to a detailed model of the plant control and protection systems. Recent SASSYS modeling developments have resulted in detailed representations of the balance of plant piping network and components, including steam generators, feedwater heaters and pumps, and the turbine. 12 refs., 2 tabs.

36922 (CONF-900804–15) **Analysis of a DRACS [Direct Reactor Auxiliary Cooling System] test COMMIX validation.** Tzanos, C.P.; Pedersen, D.R. Argonne National Lab., IL (USA). [1990]. 15p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90010128. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A large scale decay heat removal experiment was analyzed to support the validation of COMMIX and the design of Advanced Liquid Metal Reactors (ALMRs). This experiment simulated a transient where decay heat is removed by the Direct Reactor Auxiliary Cooling System (DRACS) only. It was performed in the RVACS test facility which provides a scaled simulation of the passive decay heat removal paths of a pool ALMR with the core simulated by electrically heated rods. The COMMIX predictions for the sodium pool temperatures and the outlet temperature of the direct reactor heat exchanger were in good agreement with measurements. The maximum difference between temperature predictions and measurements was less than 20 C. 4 refs., 9 figs.

36923 (CONF-900804–23) **Frequency response testing at Experimental Breeder Reactor II using discrete-level periodic signals.** Rhodes, W.D. (Idaho State Univ., Pocatello, ID (USA). Coll. of Engineering); Larson, H.A.; Dean, E.M. Argonne National Lab., IL (USA). [1990]. 15p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90011159. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The Experimental Breeder Reactor 2 (EBR-2) reactivity-to-power frequency-response function was measured with pseudo-random, discrete-level, periodic signals. The reactor power deviation was small with insignificant perturbation of normal operation and in-place irradiation experiments. Comparison of results with measured rod oscillator data and with theoretical predictions show good agreement. Moreover, measures of input signal quality (autocorrelation function and energy spectra) confirm the ability to enable this type of frequency response determination at EBR-2. Measurements were made with the pseudo-random binary sequence, quadratic residue binary sequence, pseudo-random ternary sequence, and the multifrequency binary sequence. 10 refs., 7 figs., 3 tabs.

36924 (CONF-900804–25) **Steady-state irradiation testing of U-Pu-Zr fuel to >18% burnup.** Pahl, R.G. (Argonne National Lab., Idaho Falls, ID (USA)); Wisner, R.S.; Billone, M.C.; Hofman, G.L. Argonne National Lab., IL (USA). [1990]. 9p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90011173. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Tests of austenitic stainless steel clad U-xP-10Zr fuel (x=o, 8, 19 wt. %) to peak burnups as high as 18.4 at. % have been completed in the EBR-II. Fuel swelling and fractional fission gas release are slowly increasing functions of burnup beyond 2 at. % burnup. Increasing plutonium content in the fuel reduces swelling and decreases the amount of fission gas which diffuses from fuel to plenum. LIFE-METAL code modelling of cladding strains is consistent with creep by fission gas loading and irradiation-induced swelling mechanisms. Fuel/cladding chemical interaction involves the ingress of rare-earth fission products. Constituent redistribution in the fuel had not limited steady-state performance. Cladding breach behavior at closure welds, in the gas plenum, and in the fuel column region have been benign events. 3 refs., 5 figs.

36925 (EGG-M–89264) **Multimegawatt space power reactors.** Dearien, J.A.; Whitbeck, J.F. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1989]. 39p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-8906169–2: International Astronautics Federation (IAF) conference on space power, Cleveland, OH (USA), 5-7 Jun 1989). Order Number DE90012965. Available from NTIS, PC A03/MF A01 - OSTI.

In response to the need of the Strategic Defense Initiative (SDI) and long range space exploration and extra-terrestrial basing by the National Air and Space Administration (NASA), concepts for nuclear power systems in the multi-megawatt levels are being designed and evaluated. The requirements for these power systems are being driven primarily by the need to minimize weight and maximize safety and reliability. This paper will discuss the present requirements for space based advanced power systems, technological issues associated with the development of these advanced nuclear power systems, and some of the concepts proposed for generating large amounts of power in space. 31 figs.

36926 (LA-UR–90-1285) **The AFDM [advanced fluid dynamics model] program: Scope and significance.** Bohl, W.R. (Los Alamos National Lab., NM (USA)); Parker, F.R.; Wilhelm, D.; Berthier, J. Los Alamos National Lab., NM (USA). [1990]. 11p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-900804–11: International topical meeting on fast reactor safety, Snowbird, UT (USA), 12-16 Aug 1990). Order Number DE90010585. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The origins and goals of the advanced fluid dynamics model (AFDM) program are described, and the models, algorithm, and coding used in the resulting AFDM computer program are summarized. A sample fuel-steel boiling pool calculation is presented and compared with a similar SIMMER-II calculation. A subjective assessment of the AFDM developments is given, and areas where future work is possible are detailed. 10 refs.

36927 (ORNL/FTR–3647) **[Liquid metal reactor/fast breeder reactor research and development]: Foreign trip report, June 4, 1990–June 9, 1990.** Homan, F.J. Oak Ridge National Lab., TN (USA). 20 Jun 1990. 9p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90012905. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The second meeting of the UJCC was held in Japan on June 6–8, 1990. The first day was devoted to presentations of the status of the US and Japanese Fast Breeder Reactor (FBR) programs and the status of specific areas of cooperative work. Briefly, the Japanese are following the FBR development program which has been in place since the 1970s. This program includes an FBR test reactor (JOYO), a pilot-scale reactor (MONJU), a demonstration-scale plant, and commercial-scale plants by about 2020. The US program has been redirected toward an actinide recycle mission using metal fuel and pyroprocessing of spent fuel to recovery both Pu and the higher actinides for return to the Liquid Metal Reactor (LMR). The second day was spent traveling from Tokyo to Tsuruga for a tour of the MONJU reactor. The tour was especially interesting. The third day was spent writing the minutes of the meeting and the return trip to Tokyo.

36928 (WHC-SA–0813) **Fuel aspects of Beyond Design Basis Event analyses for the Fast Flux Test Facility.** Padilla, A. Jr.; Kessler, S.F.; Dobbin, K.D.; Waltar, A.E. Westinghouse Hanford Co., Richland, WA (USA). Apr 1990. 10p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. (CONF-900804–16: International topical meeting on fast reactor safety, Snowbird, UT (USA), 12-16 Aug 1990). Order Number DE90010837. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Analyses of two Beyond Design Basis Events (transient overpower without scram and loss of flow without scram) were performed for four different core designs in the Fast Flux Test Facility using the SASSYS/SAS4A accident analysis computer code. The four core designs used the following fuels: mixed oxide, binary metal, enriched uranium oxide, and mixed nitride. Based on the numerical results for these four different fuels, a qualitative relative safety ranking was made. Nitride fuel gave the best safety performance, followed by enriched uranium oxide, binary metal, and mixed oxide. 7 refs., 6 figs., 4 tabs.

2106 Power Reactors, Auxiliary, Mobile, Package, and Transportable

36929 (DOE/ID/12754–T1) **Multimegawatt space nuclear power supply: Phase 1, Final report: Volume 2, Phase 2 plan.** Boeing Aerospace Co., Kent, WA (USA). 17 Feb 1989. 115p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-88ID12754. Order Number DE90012431. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The Phase 2 program objectives are to (1) demonstrate concept feasibility, (2) develop a preliminary design, and (3) complete Phase 3 engineering development and ground test plans. The approach to accomplish these objectives is to prove technical feasibility of our baseline design early in the program while maintaining flexibility to easily respond to changing requirements and advances in technology. This approach recognizes that technology is advancing rapidly while the operational phase MSNPS is 15 to 20 years in

the future. This plan further recognizes that the weapons platform and Advanced Launch System (ALS) are in very early program definition stages; consequently, their requirements, interfaces, and technological basis will evolve. This document outlines the Phase 2 plan along with task scheduling of the various program aspects.

36930 (DOE/ID/12754–T2) **Multimegawatt space nuclear power supply: Phase 1, Final report: Volume 3, Annotated outline of preliminary safety assessment.** Boeing Aerospace Co., Kent, WA (USA). 17 Feb 1989. 28p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-88ID12754. Order Number DE90012432. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The preliminary safety assessment report analyzes the potential radiological risk of the integrated MSNPS with the launch vehicle including interface with the weapon system. Most emphasis will be placed the prime power concept design. Safety problems can occur any time during the entire life cycle of the system including contingency phases. The preliminary safety assessment report is to be delivered at the end of phase 2. This assessment will be the basis of the safety requirements which will be applied to the design of the MSNPS as it develops in subsequent phases. The assessment also focuses design activities on specific high-risk scenarios and missions that may impact safety.

36931 (DOE/ID/12754–T3) **Multimegawatt space nuclear power supply, Phase 1 Final report: Supplement D180-30619-6.** Boeing Aerospace Co., Kent, WA (USA). 17 Feb 1989. 162p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-88ID12754. Order Number DE90012433. Available from NTIS, PC A08/MF A01 - OSTI.

This Specification establishes the performance, design, development, and test requirements for the Boeing Multimegawatt Space Nuclear Power System (MSNPS). The Boeing Multimegawatt Space Power System is part of the DOE/SDIO Multimegawatt Space Nuclear Power Program. The purpose of this program is to provide a space-based nuclear power system to meet the needs of SDIO missions. The Boeing MSNPS is a category 1 concept which is capable of delivering 10's of MW(e) for 100's of seconds with effluent permitted. A design goal is for the system to have growth or downscale capability for other power system concepts. The growth objective is to meet the category 3 capability of 100's of MW(e) for 100's of seconds, also with effluent permitted. The purpose of this preliminary document is to guide the conceptual design effort throughout the Phase 1 study effort. This document will be updated through out the study. It will thus result in a record of the development of the design effort.

36932 (ORNL/FTR–3640) **[Nuclear power engineering in space]: Foreign trip report, May 11, 1990–June 3, 1990.** Cooper, R.H. Jr. Oak Ridge National Lab., TN (USA). 18 Jun 1990. 16p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90012743. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The principal purpose of this trip was to participate in the Anniversary Specialist Conference on Nuclear Power Engineering in Space hosted by the USSR Ministry of Atomic Power Engineering and Industry. The conference was held in Obninsk, USSR. A secondary purpose of the trip was to meet with the French Commissariat A L'Energie Atomique in Paris regarding the status of their space power program.

2107 Regulation and Licensing

Refer also to citation(s) 36905, 36974, 36988

36933 (NUREG–0540-Vol.12-No.2) **Title list of documents made publicly available, February 1–28, 1990: Volume 12, No. 2.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Jun 1990. 301p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A14/MF A01 - GPO; OSTI; INIS.

The Title List of Documents Made Publicly Available is a monthly publication. It contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The docketed information contained in the Title List includes the information formerly issued through the Department of Energy publication Power Reactor Docket Information, last published in January 1979.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory and Calculation

Refer also to citation(s) 36911

2202 Components and Accessories

Refer also to citation(s) 36942, 36974, 36978, 36990, 36992, 36995

36934 (EPRI-NP–6609) **Nondestructive evaluation research progress in 1989: Proceedings from the tenth annual EPRI NDE information meeting.** Avioli, M.J. Jr. (Electric Power Research Inst., Palo Alto, CA (USA)); Behravesh, M.M.; Gehl, S.M.; Liu, S.N.; Stein, J.; Welty, C.S. Electric Power Research Inst., Palo Alto, CA (USA); COE Corp., Mountain View, CA (USA). ©Jun 1990. 375p. Sponsored by Electric Power Research Institute. (CONF-8911201–: 10. annual EPRI NDE information meeting on nondestructive evaluation research progress in 1989, Palo Alto, CA (USA), 14-15 Nov 1989). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The increasing cost of equipment for power generating plants and the potential increases in productivity and safety available through rapidity developing nondestructive evaluation (NDE) technology led EPRI to initiate a Nondestructive Evaluation Program in 1974. To date, the major focus has been on light water reactor (LWR) inspection problems; however, increased application to other systems is now under way. This report presents a comprehensive review of the EPRI effort in the NDE area. Most of the report consists of contractor-supplied progress reports on each current project. An organizational plan of the program is presented in overview. In addition, organization from several viewpoints is presented, e.g., in-service inspection operators, R&D personnel, and utility representatives. As the eleventh in a planned series of annual progress reports of EPRI-funded NDE activities, this report also serves as the proceedings of the Tenth Annual EPRI NDE Information Meeting held in Palo Alto, California, on November 14-15, 1989. It summarizes significant progress made since the previous EPRI Special Report NP-6075-SR was issued in May 1989. Section 1 contains information about the program organization, and the sections that follow contain contractor-supplied progress reports on each current project. The progress reports are grouped by plant components – pipe and nozzle, pressure vessel, and boilers and steam generators. In addition, Part 5 is devoted to discussions of technology transfer. The individual papers have been cataloged separately.

36935 (EPRI-NP–6815-D) **Detection and control of microbiologically influenced corrosion: An extension of the sourcebook for microbiologically influenced corrosion in nuclear power plants.** Licina, G.J. (Structural Integrity Associates, San Jose, CA (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Structural Integrity Associates, Inc., San Jose, CA (USA). ©1990. 96p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Sourcebook for Microbiologically Influenced Corrosion in Nuclear Power Plants (EPRI NP-5580) introduced many nuclear plant personnel to the mechanisms of MIC, provided a glossary of pertinent terms and a listing of organisms that have been associated with MIC, and gave examples of MIC from nuclear plant systems via fifteen case histories. Methods for the diagnosis, prevention,

and control of existing MIC conditions were also provided. This report expands upon the background given in EPRI NP-5580 and provides updated information on field experience with various prevention, mitigation, repair, and replacement methods. Guidelines for replacement are also provided in the event that a MCI condition cannot been prevented or controlled.

36936 (FRNC-TH-3592) **Ultrasonic signal processing and B-SCAN imaging for nondestructive testing. Application to under - cladding - cracks.** Theron, G. Paris-6 Univ., 75 (France). Feb 1988. 169p. (In French). Order Number DE90502110. Available from NTIS (US Sales Only), PC A08/MF A01.

Crack propagation under the stainless steel cladding of nuclear reactor vessels is monitored by ultrasonic testing. This work study signal processing to improve detection and sizing of defects. Two possibilities are examined: processing of each individual signal and simultaneous processing of all the signals giving a B-SCAN image. The bibliographic study of time-frequency methods shows that they are not suitable for pulses. Then decomposition in instantaneous frequency and envelope is used. Effect of interference of 2 close echoes on instantaneous frequency is studies. The deconvolution of B-SCAN images is obtained by the transducer field. A point-by-point deconvolution method, less noise sensitive, is developed. B-SCAN images are processed in 2 phases: interface signal processing and deconvolution. These calculations improve image accuracy and dynamics. Water-stell interface and ferritic-austenitic interface are separated. Echoes of crack top are visualized and crack-hole differentiation is improved.

2203 Fuel Elements

Refer also to citation(s) 36915, 36986, 36997

2204 Control Systems

Refer also to citation(s) 36990, 36991, 37234

36937 (CONF-900804-21) **Design of a reactor inlet temperature controller for EBR-2 using state feedback.** Vilim, R.B.; Planchon, H.P. Argonne National Lab., IL (USA). [1990]. 11p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90011157. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A new reactor inlet temperature controller for pool type liquid-metal reactors has been developed and will be tested in EBR-II. The controller makes use of modern control techniques to take into account stratification and mixing in the cold pool during normal operation. Secondary flowrate is varied so that the reactor inlet temperature tracks a setpoint while reactor outlet temperature, primary flowrate and secondary cold leg temperature are treated as exogenous disturbances and are free to vary. A disturbance rejection technique minimizes the effect of these disturbances on inlet temperature. A linear quadratic regulator improves inlet temperature response. Tests in EBR-II will provide experimental data for assessing the performance improvements that modern control can produce over the existing EBR-II analog inlet temperature controller. 10 refs., 8 figs.

36938 (CONF-900804-26) **Quantitative studies of severe fuel damage using delayed neutron data.** Bauer, T.H. (Argonne National Lab., IL (USA)); Braid, T.H.; Schleisiek, K. Argonne National Lab., IL (USA). [1990]. 11p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90011175. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A technique to quantify fuel damage in an LMR through analysis of delayed neutron data is presented, which is suitable for analysis of both small-scale in-pile experiments and full-scale plants. Validating analyses are described for five in-pile severe accident simulations performed within the SLSF and Mol 7C test programs. Comparison is made of measured and calculated amounts of fuel damage. 8 refs., 5 figs., 2 tabs.

36939 (NUREG/CR-5439) **Human factors issues associated with advanced instrumentation and controls technologies in nuclear plants.** Carter, R.J. (Oak Ridge National Lab., TN (USA)); Uhrig, R.E. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Oak Ridge National Lab., TN (USA). Jun 1990. 193p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/TM-11319). Available from NTIS, PC A09/MF A01 - GPO; OSTI; INIS.

A survey of advanced instrumentation and controls (I&C) technologies and associated human factors issues in the US and Canadian nuclear industries was carried out by a team from Oak Ridge national laboratory to provide background for the development of regulatory policy, criteria, and guides for review of advanced I&C systems as well as human engineering guidelines for evaluating these systems. The survey found those components of the US nuclear industry surveyed to be quite interested in advanced I&C, but very cautious in implementing such systems in nuclear facilities and power plants. The trend in the facilities surveyed is to experiment cautiously when there is an intuitive advantage or short-term payoff. In the control room, the usual practice is direct substitution of digital and microprocessor-based instruments or systems that are functionally identical to the analog instruments or systems being replaced. The most advanced I&C systems were found in the Canadian CANDU plants, where the newest plant has digital system in almost 100% of its control systems and in over 70% of its plant protection system. The hypothesis that properly "introducing digital systems increases safety" is supported by the Canadian experience. The performance of these digital systems was achieved using an appropriate quality assurance program for the software development. The ability of digital systems to detect impending failures and initiate a fail-safe action, is a significant safety issue that should be of special interest to every US utility as well as to the US Nuclear Regulatory Commission. 12 refs. 5 tabs.

36940 (ORNL/FTR-2887) **[Passive monitoring of nuclear systems]: Foreign trip report, May 18-30, 1988.** Difilippo, F.C. Oak Ridge National Lab., TN (USA). 10 Jun 1988. 8p. DOE Contract AC05-84OR21400. Order Number DE90012369. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler participated in a seminar at the Institute of Nuclear Technology, in Madrid, Spain, with members of the host institution and the nuclear industry (utilities and vendors). The topics discussed at the seminar were stochastics methods for the diagnosis and detection of anomalies in nuclear systems and nonlinear dynamics and chaos in nuclear reactors. The Institute is interested in promoting the use of these techniques for the surveillance of nuclear plants in Spain and the Institute wants to convince the utilities to allow access to their plants for measurements. The Director of the Institute expressed interest in collaborating with the Oak Ridge National Laboratory in the implementation of these techniques and they are willing to share the databank to be obtained with ORNL. The stop in Madrid was on the way to Valencia, Spain, where the traveler participated as co-director and author in the NATO Advanced Research Workshop entitled "Noise and Nonlinear Phenomena in Nuclear Systems." Thirty-five papers were discussed at the meeting by participants from 14 different countries (9 of them NATO members). The presentations covered basic and applied aspects of the subject with the following implications for DOE/NRC programs: (1) the use of the third moment to describe stochastic variables can be used to detect nonlinear processes related to the abnormal behavior of nuclear systems and to monitor criticality; (2) the analysis of xenon oscillations and the development of optimal control concepts, subjects that are relevant to the design of the Advanced Neutron Source, have already been influenced by the boom of the nonlinear analysis in the physical sciences. Similar impacts were noticed in the stability analysis and the analysis of mechanical vibrations in nuclear reactors.

36941 (ORNL/TM-11296) **Designing an AI-environment prototype for the automatic startup of EBR-II [Experimental Breeder Reactor-II].** Corcuera, R.P. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados); Ford, C.E.; Ball, S.J.; Perez, R.B. Oak Ridge National Lab., TN (USA). Jun 1990. 21p. Sponsored by U.S. DOE Energy Research.

DOE Contract AC05-84OR21400. Order Number DE90011268. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A status report on an artificial intelligence (AI) environment procedure-prompting prototype is presented. This program would permit replacement of hard copy of the Experimental Breeder Reactor-II (EBR-II) written operating procedures for plant startup with a computerized procedures manual. It is expected that with this approach, the computerized system would be able to assist reactor operators and managers by making procedures available rapidly, displaying the appropriate procedure steps, and performing on-line checks of plant parameters when required. 14 refs.

36942 Transactions on the 10th international conference on structural mechanics in reactor technology. Volume B. Computational mechanics. Hadjian, A.H. (Bechtel Power Corp., Los Angeles, CA (USA)). 419p. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This book contains the transactions of the 10th International Conference on Structural Mechanics in Reactor Technology, Volume B, Computational Mechanics. Topics covered include: Boundary elements; Inelastic plates and shells; Computer-aided design; Plasticity; and Thermal Problems.

36943 Risk-based inspection guidelines. Balkey, K.R. (Westinghouse Electric Corp. (US)); Ayyub, B.M.; Gore, B.F.; Simonen, F.A.; Harris, D.O.; Karydas, D.; Smith, H. Jr.; Chapman, O.J.V. *Mechanical Engineering (USA)*, 112(3): 68 (Mar 1990).

In-service inspections can play a significant role in minimizing equipment and structural failures. However, for many components that are required to maintain pressure boundary integrity or that are subjected to severe service conditions in the nuclear power, fossil-fired power, and the petroleum and chemical processing industries as well as other applications, in-service inspection requirements are either established based upon prior experience and engineering judgment or are nonexistent. Given this situation, the ASME Codes and Standards Research Planning Committee suggested that a research program be initiated to determine how risk-based methods could be used to establish inspection requirements and guidelines for systems and components of interest to mechanical engineers. This article outlines the research program that was approved by the ASME Board on Research and Technology Development and the ASME Council on Codes and Standards.

2205 Environmental Aspects

Refer also to citation(s) 36970, 36986

36944 (NUREG/CR–5480) **Data summary report for fission product release test VI-3.** Osborne, M.F. (Oak Ridge National Lab., TN (USA)); Lorenz, R.A.; Collins, J.L.; Travis, J.R.; Webster, C.S.; Lee, H.K.; Nakamura, T.; Tong, Y.-C. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Oak Ridge National Lab., TN (USA). Jun 1990. 60p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/TM–11399). Available from NTIS, PC A04/MF A01 - GPO; OSTI; INIS.

Test VI-3, the third in a series of high-temperature fission product release tests in the vertical test apparatus, was conducted in flowing steam. The test specimen was a 15.2-cm-long section of a fuel rod from the BR3 reactor in Belgium, which had been irradiated to a burnup of 42 MWd/kg. Using an induction furnace, it was heated under simulated light-water reactor (LWR) accident conditions to two test temperatures, 20 min at 2000 K and then 20 min at 2700 K, in a hot cell-mounted test apparatus. The released fission products were collected on components designed to facilitate sampling and analysis. Posttest inspection confirmed that the cladding had been completely oxidized during the test. Only minimal fragmentation of the fuel specimen was found, however, and very little melting or fuel-cladding interaction had occurred. Based on fission product inventories measured in the fuel or calculated by ORIGEN2, analyses of test components showed total releases from the fuel of 100% for ^{85}Kr, 5% for ^{106}Ru, 99% for ^{125}Sb, and 99% for both ^{134}Cs and ^{137}Cs. A large fraction (27%) of the released ^{125}Sb was retained in the furnace, but most of the released cesium (89%) escaped to the collection system. In addition, very small amounts of fuel material — uranium and plutonium — were released. Including fission products and fuel and structural materials, the total mass released from the furnace to the collection system was 3.17 g, 78% of which was collected on the filters. The results from this test were compared with previous tests in this series and with a commonly used model for fission product release. 25 refs., 22 figs., 14 tabs.

2206 Research, Test, and Experimental Reactors

Refer also to citation(s) 36924, 36928, 36951, 36954, 36956, 36959, 36963, 36970, 36971, 37407

36945 (CONF-900563–12) **Proposed neutron activation analysis facilities in the Advanced Neutron Source.** Robinson, L.; Dyer, F.F.; Emery, J.F. Oak Ridge National Lab., TN (USA). [1990]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 7. symposium on radiation measurements and applications; Ann Arbor, MI (USA); 21-24 May 1990. Order Number DE90012781. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A number of analytical chemistry experimental facilities are being proposed for the Advanced Neutron Source. Experimental capabilities will include gamma-ray analysis and neutron depth profiling. This paper describes the various systems proposed and some of their important characteristics.

36946 (CONF-900804–2) **Run - Beyond - Cladding - Breach (RBCB) test results for the Integral Fast Reactor (IFR) metallic fuels program.** Batte, G.L. (Argonne National Lab., Idaho Falls, ID (USA)); Hoffman, G.L. Argonne National Lab., IL (USA). [1990]. 7p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90005662. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

In 1984 Argonne National Laboratory (ANL) began an aggressive program of research and development based on the concept of a closed system for fast-reactor power generation and on-site fuel reprocessing, exclusively designed around the use of metallic fuel. This is the Integral Fast Reactor (IFR). Although the Experimental Breeder Reactor-II (EBR-II) has used metallic fuel since its creation 25 yeas ago, in 1985 ANL began a study of the characteristics and behavior of an advanced-design metallic fuel based on uranium-zirconium (U-Zr) and uranium-plutonium-zirconium (U-Pu-Zr) alloys. During the past five years several areas were addressed concerning the performance of this fuel system. In all instances of testing the metallic fuel has demonstrated its ability to perform reliably to high burnups under varying design conditions. This paper will present one area of testing which concerns the fuel system's performance under breach conditions. It is the purpose of this paper to document the observed post-breach behavior of this advanced-design metallic fuel. 2 figs., 1 tab.

36947 (CONF-9002100–) **IGORR-1: Proceedings of the first meeting of the international group on research reactors.** West, C.D. (comp.). Oak Ridge National Lab., TN (USA). May 1990. 262p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. From International Group on Research Reactors conference; Knoxville, TN (USA); 28 Feb - 2 mar 1990. Order Number DE90012973. Available from NTIS, PC A12/MF A01; OSTI; INIS; GPO Dep.

Many organizations, in several countries, are planning or implementing new or upgraded research reactor projects, but there has been no organized forum devoted entirely to discussion and exchange of information in this field. Over the past year or so, informal discussions resulted in widespread agreement that such a forum would serve a useful purpose. Accordingly, a proposal to form a group was submitted to the leading organizations known to be involved in projects to build or upgrade reactor facilities. Essentially all agreed to join in the formation of the International Group on Research Reactors (IGORR) and nominated a senior staff member to serve on its international organizing committee. The

first IGORR meeting took place on February 28–March 2, 1990. It was very successful and well attended; some 52 scientists and engineers from 25 organizations in 10 countries participated in 2-1/2 days of open and informative presentations and discussions. Two workshop sessions offered opportunities for more detailed interaction among participants and resulted in identification of common R&D needs, sources of data, and planned new facilities. Individual papers have been cataloged separately.

36948 (KURRI-TR–327, pp. 64-69) **Installation and performance tests of KUR cold neutron source, 1: Structure and safety design.** Utsuro, Masahiko (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Maeda, Yutaka; Kawai, Takeshi. Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jan 1990. (In Japanese). (CONF-8901187–: Workshop on the cooling of high-performance reactors, Kumatori (Japan), 17-18 Jan 1989). In *Proceedings of the workshop on the cooling of high-performance reactors.* Order Number DE90777871. Available from NTIS (US Sales Only), PC A08/MF A01.

The first reactor cold neutron source in Japan installed into the graphite thermal column of KUR is described with its fundamental structures and the safety design aspects. Liquid deuterium and hydrogen mixture of about 4 litres was decided as the cold moderator from the optimized design in our case. The cold moderator chamber was made of thin aluminium alloy, and a helium-neon safety blanket is also provided on the vacuum insulation container. These important portions with the hydrogen condenser and liquid transfer tubes were manufactured as a completely unified machine with the highest quality of welding. The principle so called 2-out-of-3 system with a high reliability is employed in the important instrumentations. A series of condensation and steady operation tests, including the later start-up of cooling under full power reactor operations, on liquid hydrogen moderator showed quite satisfactory performances of the present cold source. The deuterization and the neutron guide tubes preparations are now under progress. (author).

36949 (SAND–90-0383C) **Annular core research reactor high flux neutron radiography facility.** McCrory, F.M.; Kelly, J.G.; Vernon, M.E.; Tichenor, D.A. Sandia National Labs., Albuquerque, NM (USA). [1990]. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900873–1: 1. international topical meeting on neutron radiography system design and characterization, Pembroke (Canada), 28-30 Aug 1990). Order Number DE90007072. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Sandia National Laboratories (SNL) has been performing neutron radiography since 1964. The radiography facilities have evolved from an aperture in a radiation exposure room in the now retired Sandia Engineering Reactor to a divergent collimator radiography facility adjacent to the core of the Annular Core Research Reactor (ACRR). The maximum thermal neutron flux achieved in these facilities has been limited to approximately 1×10^7 n-cm^{-2}-s^{-1}. In order to perform high-resolution, real-time neutron radiography for transient events, higher neutron fluxes are required. In response to this need, Sandia is designing a new high-flux neutron radiography facility for the ACRR. The new facility uses the central irradiation cavity of the ACRR and consists of a collimator assembly, reactor control system, an experiment support structure, and an imaging system. This new facility is described in this paper. 2 refs., 2 figs.

2207 Plutonium and Isotope Production Reactors

Refer also to citation(s) 36902, 36967, 37012

36950 (EGG-NE–8940) **Reactivity studies on the final preconceptual reference design of the Advanced Neutron Source.** Ryskamp, J.M.; Redmond, E.L. II; Kim, S.S.; Fletcher, C.D. EG and G Idaho, Inc., Idaho Falls, ID (USA). Apr 1990. 29p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE90013098. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

An Advanced Neutron Source (ANS) with a peak thermal neutron flux of $8.0 - 9.0 \times 10^{19}$ m^{-2}s^{-1} is being designed for condensed matter physics, materials science, isotope production, and fundamental physics research. A final preconceptual reference reactor design has been selected in order to examine the safety, performance, and costs associated with this one design. This report presents reactor physics analyses of safety aspects of the reference reactor design that are related to core reactivity changes. These analyses include control rod worth, shutdown rod worth, heavy water voiding, light water ingress, single fuel element criticality, fuel element movement, and neutron beam tube flooding. The positive and negative findings are explored for each of these analyses. Based on these analyses, some design modifications that further improve the reactor safety are identified and recommended. 12 refs., 4 figs., 16 tabs.

2208 Propulsion Reactors

Refer also to citation(s) 36902

2209 Reactor Safety

Refer also to citation(s) 36902, 36915, 36916, 36917, 36918, 36919, 36921, 36922, 36926, 36928, 36929, 36930, 36931, 36934, 36938, 36939, 36944, 36946, 36947, 36950, 37012, 37025, 37327, 37375, 37392

36951 (CEA-DAS–657) **Taking into account a reactivity accident in research reactors design.** Abou Yehia, H.; Berry, J.L.; Sinda, T. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Nov 1989. 13p. (In French). (CONF-891027–: International symposium on research reactor safety, operations and modifications, Chalk River (Canada), 23-27 Oct 1989). Order Number DE90500777. Available from NTIS (US Sales Only), PC A03/MF A01.

The particular studies realized in France for research reactors design at a Borax accident type are described. The cases of ORPHEE and RHF reactors are particularly developed. The evolution of the studies and the conservatism used are given.

36952 (CEA-DAS–661) **Presentation of the ressac research program (rehabilitation of soils and surfaces after an accident).** L'Homme, A. (CEA Centre d'Etude Nucleaires de Fontenay-aux-Roses, 92 (FR). Dept. d'Analyse de Surete); Parmentier, N.; Legrand, B.; Fache, P. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Nov 1989. 12p. (CONF-891108–: International symposium on recovery operation in the event of a nuclear accident or radiological emergency, Vienna (Austria), 6-10 Nov 1989). Order Number DE90500771. Available from NTIS (US Sales Only), PC A03/MF A01.

If, despite all the precautions taken in nuclear power plants, a severe accident was to occur in France involving extensive release of radioactive materials to the environment, existing emergency plans would be implemented enabling urgent decisions to be made with regard to the immediate protection of the population: confinement indoors, evacuation, distribution of stable iodine, etc. But, at a later stage, mean and long term actions would have to be carried out to decontaminate the polluted areas and limit subsequent contamination of the food chain, with a view to enabling the populations concerned to return to normal life. These actions would concern, in decreasing order of priority and using the WHO and IAEA definitions, the near field, closest to the accident site, and the far field, subjected to the direct impact of fallout. They should be aimed at reducing external exposure due to deposition and internal exposure by inhalation of radioactive products re-suspended in the atmosphere and by ingestion of products for human consumption. In the context of IPSN (Institute of Protection and Nuclear Safety) research and development programs on severe accidents, the RESSAC program was defined in 1985 for the purpose of studying methods and means of rehabilitating the near field and controlling problems related to the far field. Elaboration of the program is presently proceeding at the Nuclear Research Center of CADARACHE, focussed on the following main topics: assessment of what happens to the radionuclides deposited on the soil and vegetation, determination of priorities and how to intervene, management of the waste produced.

36953 (CONF-900804–4) **Fuel motions in the multi-pin PFR/TREAT test series.** Doemer, R.C.; Bauer, T.H.; Robinson, W.R.; Wright, A.E. Argonne National Lab., IL (USA). [1990]. 9p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90010098. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Fuel motions during the early stages of failure were determined for the seven multi-pin PFR/TREAT tests from an integrated analysis of data from the Fast Neutron Hodoscope and the loop instrumentation. It was observed that motion in TUCOP simulations is in two stages; an initial slow movement at failure followed by abrupt dispersal. It was also found that axial movement of fresh fuel begins promptly at initial failure but that pre-irradiated fuel motion is delayed by 15 ms in both TOP and TUCOP simulations.

36954 (CONF-900804–5) **Transient feedback from fuel motion in metal IFR [Integral Fast Reactor] fuel.** Rhodes, E.A.; Stanford, G.S.; Regis, J.P.; Bauer, T.H.; Dickerman, C.E. Argonne National Lab., IL (USA). [1990]. 12p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90010136. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Results from hodoscope data analyses are presented for TREAT transient-overpower tests M5 through M7 with emphasis on transient feedback mechanisms, including prefailure expansion at the tops of the fuel pins, subsequent dispersive axial fuel motion, and losses in relative worth of the fuel pins during the tests. Tests M5 and M6 were the first TOP tests of margin to cladding branch and prefailure elongation of D9-clad ternary (U-Pu-Zr) IFR-type fuel. Test M7 extended these results to high-burnup fuel and also initiated transient testing of HT9-clad binary (U-Zr) FFTF-driver fuel. Results show significant prefailure negative reactivity feedback and strongly negative feedback from fuel driven to failure. 4 refs., 6 figs.

36955 (CONF-900804–12) **Performance of metal and oxide fuels during accidents in a large liquid metal cooled reactor.** Cahalan, J. (Argonne National Lab., IL (USA)); Wigeland, R.; Friedel, G.; Kussmaul, G.; Royl, P.; Moreau, J.; Perks, M. Argonne National Lab., IL (USA). [1990]. 12p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90010582. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

In a cooperative effort among European and US analysts, an assessment of the comparative safety performance of metal and oxide fuels during accidents in a large (3500 MWt), pool-type, liquid-metal-cooled reactor (LMR) was performed. The study focused on three accident initiators with failure to scram: the unprotected loss-of-flow (ULOF), the unprotected transient overpower (UTOP), and the unprotected loss-of-heat-sink (ULOHS). Emphasis was placed on identification of design features that provide passive, self-limiting responses to upset conditions, and quantification of relative safety margins. The analyses show that in ULOF and ULOHS sequences, metal-fueled LMRs with pool-type primary systems provide larger temperature margins to coolant boiling than oxide-fueled reactors of the same design. 3 refs., 4 figs.

36956 (CONF-900804–17) **An overview of the EBR-II PRA [Probabilistic Risk Assessment].** Hill, D.J. (Argonne National Lab., IL (USA)); Chang, Y.W.; Deitrich, L.W.; Ragland, W.A.; Lehto, W.K.; Schaeffer, R.W. Argonne National Lab., IL (USA). [1990]. 10p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90011095. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Experimental Breeder Reactor-II, EBR-II, is a 60 MW(t) liquid sodium cooled, pool type fast reactor which has operated successfully as a power reactor and irradiation facility for over 25 years. Argonne National Laboratory is currently performing a Probabilistic Risk Assessment of EBR-II. An overview of the PRA is presented with special attention to those issues which are important to EBR-II such as the passive decay heat removal capabilities and the passive shut down capability provided by the reactivity feedbacks. 7 refs., 3 figs., 1 tab.

36957 (CONF-900804–18) **Consequences of pipe ruptures in metal fueled, liquid metal cooled reactors.** Dunn, F.E. Argonne National Lab., IL (USA). [1990]. 12p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90011096. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The capability to simulate pipe ruptures has recently been added to the SASSYS-1 LMR systems analysis code. Using this capability, the consequences of severe pipe ruptures in both loop-type and pool-type reactors using metal fuel were investigated. With metal fuel, if the control rods scram then either type of reactor can easily survive a complete double-ended break of a single pipe; although, as might be expected, the consequences are less severe for a pool-type reactor. A pool-type reactor can even survive a protected simultaneous breaking of all of its inlet pipes without boiling of the coolant or melting of the fuel or cladding. 2 refs., 16 figs., 1 tab.

36958 (CONF-900804–19) **Joint US/Japanese program of full-size building tests for base seismic isolation.** Kuroda, T. (Shimizu Corp., Tokyo (Japan). Nuclear Power Div.); Chang, Y.W.; Seidensticker, R.W. Argonne National Lab., IL (USA). [1990]. 28p. Sponsored by National Science Foundation. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90011156. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Agreement CES-8800871.

Shimizu Corporation of Japan and Argonne National Laboratory of the USA initiated a joint research program on base seismic isolation. The program is centered on testing and analyzing isolation systems in a full-size building and to obtain data on relative response between isolated and nonisolated structures under earthquake conditions. The test facility consists of two identical full-size three-story buildings built side by side, located at Tohoku University in Sendai, Japan. Since April 1989, after the installation of bearings, over 20 earthquake data have been recorded at Sendai test facility. This paper describes the test facility, isolation bearings, observed earthquake records, and responses of isolated and nonisolated buildings under earthquake loads. 3 refs., 15 figs.

36959 (CONF-900804–20) **Fuel damage during off-normal transients in metal-fueled fast reactors.** Kramer, J.M.; Bauer, T.H. Argonne National Lab., IL (USA). [1990]. 11p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90011169. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Fuel damage during off-normal transients is a key issue in the safety of fast reactors because the fuel pin cladding provides the primary barrier to the release of radioactive materials. Part of the Safety Task of the Integral Fast Reactor Program is to provide assessments of the damage and margins to failure for metallic fuels over the wide range of transients that must be considered in safety analyses. This paper reviews the current status of the analytical and experimental programs that are providing the bases for these assessments. 13 refs., 2 figs.

36960 (CONF-900804–22) **A measurement-based method for predicting margins and uncertainties for unprotected accidents in the Integral Fast Reactor concept.** Vilim, R.B. Argonne National Lab., IL (USA). [1990]. 10p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90011158. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A measurement-based method for predicting the response of an LMR core to unprotected accidents has been developed. The method processes plant measurements taken at normal operation to generate a stochastic model for the core dynamics. This model can be used to predict three sigma confidence intervals for the

core temperature and power response. Preliminary numerical simulations performed for EBR-2 appear promising. 6 refs., 2 figs.

36961 (CONF-900804–24) **Whole-Pin Furnace system: An experimental facility for studying irradiated fuel pin behavior under potential reactor accident conditions.** Liu, Y.Y.; Tsai, H.C.; Donahue, D.A.; Pushis, D.O.; Savoie, F.E.; Holland, J.W.; Wright, A.E.; August, C.; Bailey, J.L.; Patterson, D.R. Argonne National Lab., IL (USA). May 1990. 9p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90011150. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The whole-pin furnace system is a new in-cell experimental facility constructed to investigate how irradiated fuel pins may fail under potential reactor accident conditions. Extensive checkouts have demonstrated excellent performance in remote operation, temperature control, pin breach detection, and fission gas handling. The system is currently being used in testing of EBIR-II-irradiated Integral Fast Reactor (IFR) metal fuel pins; future testing will include EBR-II-irradiated mixed-oxide fuel pins. 7 refs., 4 figs.

36962 (CONF-900804–27) **The passive response of the Integral Fast Reactor concept to the chilled inlet accident.** Vilim, R.B. Argonne National Lab., IL (USA). [1990]. 10p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90011176. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Simple methods are described for bounding the passive response of a metal fueled liquid-metal cooled reactor to the chilled inlet accident. Calculation of these bounds for a prototype of the Integral Fast Reactor concept shows that failure limits — eutectic melting, sodium boiling and fuel pin failure — are not exceeded. 2 refs., 1 fig., 2 tabs.

36963 (CONF-900804–28) **EBR-II in-vessel natural circulation experiments on hot and cold pool stratification.** Ragland, W.A.; Feldman, E.E. Argonne National Lab., IL (USA). [1990]. 10p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990. Order Number DE90011148. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The Experimental Breeder Reactor II is located in a cylindrical pool of liquid sodium which is part of the cold-leg of the primary flow circuit. A vertical string of 32 thermocouples spans the 8 m tank height, at each of two diametrically opposed locations in the primary tank. Local temperatures were measured with these 64 thermocouples during dynamic tests. The instantaneous spacial temperature distribution obtained from a string of thermocouples can be viewed on a personal computer. The animation which results from displaying successive spacial distributions provide a very effective way to quickly obtain physical insights. The design of the two strings of thermocouples, the software used to create the animation, measured data from three different types of tests–two unprotected reactor transients, and one with the reactor at decay power levels and the reactor cover lifted, are discussed. 5 refs., 3 figs.

36964 (DOE/ID–10259) **Simulation of Phases 3 and 4 of the TMI-2 accident using MAAP-DOE and MAAP 3.0B, Task 3.9.** Malinovic, B. (Fauske and Associates, Inc., Burr Ridge, IL (USA)); Sharon, A. EG and G Idaho, Inc., Idaho Falls, ID (USA). Apr 1990. 105p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570 ;W-31109-ENG-38. (MISC–89132). Order Number DE90013097. Available from NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

Phases 3 and 4 of the TMI-2 accident have been simulated using both MAAP 3.0B and the enhanced MAAP code version developed for the US Department of Energy (DOE). Predictions based on MAAP 3.0B are only fair, since the MAAP 3.0B version of the code does not model degraded core recovery. Predictions with the DOE enhanced version of MAAP are successful for Phase 3 of the accident, but not as successful for Phase 4. Primary system pressure and hydrogen generation, as predicted by the DOE code version for Phase 3, are in agreement with plant data and best estimate analyses. Code results indicate that the relocation at 224 times could not have occurred, in contrast to the actual plant end state. Results for core temperature and pressurizer level indicate that heat transfer from the core, and therefore the steaming rate from the vessel, may have been overestimated during Phase 4 of the accident. For Phase 4, these factors contribute to the disagreement between code predictions for pressurizer level and primary system pressure, and plant data. 22 refs., 34 figs., 5 tabs.

36965 (DOE/ID–10271) **Prevention of early containment failure due to high pressure melt ejection and direct containment heating for advanced light water reactors: Advanced Reactor Severe Accident Program.** Carter, J.C. III (TENERA, L. P., Knoxville, TN (USA)); Fontana, M.H.; Additon, S.L.; Summitt, R.L.; Henry, R.E.; Hammersley, R.J. EG and G Idaho, Inc., Idaho Falls, ID (USA). Mar 1990. 195p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (MISC–90032). Order Number DE90012962. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

The current knowledge base on high pressure melt ejection (HPME) and its consequence, direct containment heating (DCH), has been examined by the Department of Energy (DOE) Advanced Reactor Severe Accident Program (ARSAP) for advanced light water reactors (ALWRs). A two-pronged approach for the design of evolutionary advanced pressurized water reactors (APWRs) has been developed for minimizing the potential for early containment failure due to an HPME event that involves DCH. Criteria are provided for APWR reactor cavity and lower containment configurations to limit the amount of debris and energy that could enter the upper containment atmosphere; this provides a passive method for mitigating DCH. Also, the means for rapid, deliberate reactor coolant system (RCS) depressurization are provided in APWRs; depressurization can be used prior to reactor vessel meltthrough to minimize high pressure driving forces, thereby preventing DCH. This report summarizes the technical bases, both experimental and analytical, supporting a conclusion that these design approaches preclude early containment failure due to HPME for risk-relevant sequences in APWRs. 50 refs., 11 figs., 5 tabs.

36966 (DOE/NCT–01) **Review of the state of criticality of the Three Mile Island Unit 2 core and reactor vessel.** Stratton, W.R. (GPU Nuclear Corp., Middletown, PA (USA)). Lawrence Livermore National Lab., CA (USA). 15 Apr 1987. 36p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90013082. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The events during the early hours of the Three Mile Island Unit 2 (TMI-2) accident on March 28, 1979 caused the fuel in the reactor core to crumble or disintegrate, and then subside into a rubble structure more compact that its normal configuration. The present height of the core is about seven feet, five feet less than its normal configuration of 12 feet. With the same boron content and some or all of the control rod and burnable poison rod material as the normal core configuration, the collapsed structure is calculated to be more reactive. However, the reactor is assuredly subcritical at present because of the extraordinarily high boron concentration maintained in the coolant water. Four additional and different physical models are discussed briefly in the report to illustrate the margin of subcriticality, to provide a better estimate of the neutron multiplication factor, and to provide some understanding of the criticality effects of the important parameters. Two different finite, cylindrical models of a collapsed core are also presented in this report. The conclusion of this review is that the reactor is now very far subcritical with a boron concentration of 4350 ppM or more, and no conceivable rearrangement of fuel can create a critical state. Careful administrative control to maintain the boron concentration of the reactor coolant close to 5000 ppM, and controls to rigorously exclude addition of unborated water to the primary system, provide additional assurance that subcriticality will be maintained. The immediate corollary is that the defueling of the reactor vessel can proceed as planned, with complete confidence that such operations will remain subcritical. 20 refs.

36967 (EGG-EAST–8508) **Extensions to SCDAP/RELAP5/MOD2 debris analysis models for the severe accident analysis**

of Savannah River Site (SRS) reactors preliminary design report. Siefken, L.J.; Moore, R.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). Jun 1989. 49p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE90013096. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

Proposed extensions to the debris analysis model in the SCDAP/RELAP5 code to perform severe accident analyses of Savannah River Plant reactors are described. Designs are presented for the following areas of development: (a) calculating convective and radiative heat transfer at the surfaces of a debris region; (b) calculating heatup of a structure and supported debris that interfaces with several fluid control volumes; (c) modeling the addition of transported material to the surfaces of any structure represented by the debris analysis model; (d) calculating the two-dimensional heatup of an arbitrary number of structures in the reactor system; (e) modeling the effect of natural convection of liquefied material on heat transfer in a debris bed; and (f) modeling fission product release and aerosol generation in a debris bed. 11 refs., 12 figs., 7 tabs.

36968 (EGG-M–89161) **MAAP [Modular Accident Analysis Program] steam generator modeling and benchmarking with Westinghouse MB-2 tests.** Paik, Chan Y. (Fauske and Associates, Inc., Burr Ridge, IL (USA)); Sharon, A.; Hammersley, R.J. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1989]. 11p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-891103–75: Winter meeting of the American Nuclear Society (ANS) and nuclear power and technology exhibit, San Francisco, CA (USA), 26-30 Nov 1989). Order Number DE90012955. Available from NTIS, PC A03/MF A01; OSTI; INIS.

A generalized theoretical model has been developed and numerically implemented to predict the thermal hydraulic response of a U-tube steam generator during various transients such as steam line break, steam generator tube rupture, loss of feed water, and primary side transients. A two region model is used with a simple and fast running code to calculate essential state variables. It can simulate all the transients from normal to the extreme conditions such as when the secondary side contains superheated steam with non-condensable gases and no water. Comparisons are made to the data of the Westinghouse Model Boiler No. 2 (MB-2) test[1] for five types of transient: (1) 100% steam line break from hot standby condition, (2) 50% steam line break from hot standby condition. (3) 8% steam line break with steam generator tube rupture, (4) loss of feedwater from 100% power without reactor scram, and (5) loss of feed water from 100% power with reactor scram. Good agreement is observed between the model predictions and the test data. 9 refs., 16 figs.

36969 (EGG-M–89199) **Alarm Processing System.** Di Domenico, P. (Bechtel National, Inc., San Francisco, CA (USA)); Mah, E.; Corsberg, D.; Somsel, J.; Chan, J.K.; Naser, J.; Scarl, E. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1989]. 19p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-890634–2: Expert systems applications for the electric power industry conference, Orlando, FL (USA), 5-8 Jun 1989). Order Number DE90013091. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During power plant transients, a control room operator is deluged with large amounts of diverse information of varying degrees of importance and in different format. Control room operators are sometimes overwhelmed. They are required to make quick decisions based on operating procedures thereby bypassing most deep-level reasoning. The application of expert systems to process alarms and to perform diagnosis can substantially improve the quality of information presented to operators. The high-level goal of the Alarm Processing System is for operators to enthusiastically accept a new technology that will improve their response to alarms during plant transient conditions. The Alarm Processing System dynamically prioritizes alarms based on the state of the plant; reduces the amount of information presented to the operator by grouping and displaying alarms in accordance with the present state of the plant; and allows nuisance alarms to be suppressed. Object-oriented programming techniques are used to describe plant analog and binary sensors, alarms, and plant states. The system reasons about nuisance signals taken off-line by using logic system that has three states: true, false, and null. A null or invalid state is propagated through the logic until the operator can assign a derived value for the signal. 5 refs., 7 figs.

36970 (EGG-M–90152) **Postirradiation examination results from the LP-FP-2 center fuel module.** Jensen, S.M.; Akers, D.W. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 60p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-9005179–2: Loss of Fluid Test final meeting (achievements of the OECD LOFT Project), Madrid (Spain), 8-11 May 1990). Order Number DE90012966. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

The LP-FP-2 experiment was conducted on July 9, 1985 in the Loss of Fluid Test (LOFT) facility located at the Idaho National Engineering Laboratory (INEL). The primary purpose of this experiment was to provide information of the release, transport, and deposition of fission products and aerosols during a sever core damage event performed in a large scale nuclear reactor facility. Postirradiation nondestructive and destructive examinations of the fuel bundle provided information to assist in achieving this objective, as well as providing information on the material behavior and interactions that occurred within the fuel bundle during this sever core damage experiment. This was a large-scale integral test, incorporating an 11 × 11 array of fuel rods, control rods, and instrumentation tubes, with an active core length of 1.68 m. Peak temperatures in the fuel bundle exceeded 2100 K or approximately 4.5 min, with localized peak temperatures exceeding the melting point of the UO_2 fuel (3120 K). Large amounts of zircaloy oxidation and material relocation occurred during the experiment. The transient phase was terminated by a rapid reflood of cooling water, which resulted in significant oxidation and hydrogen generation. Zircaloy oxidation during the reflood period caused a rapid temperature excursion to occur in the upper two-thirds of the fuel bundle. This article summarizes the data and analysis from the postirradiation examinations of the LP-FP-2 fuel bundle. 12 refs., 39 figs., 8 tabs.

36971 (EGG-M–90165) **The LP-FP-2 severe fuel damage scenario and discussion of the relative influence of the transient and reflood phases in affecting the final condition of the bundle.** Modro, S.M.; Carboneau, M.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 15p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-9005179–3: Loss of Fluid Test final meeting (achievements of the OECD LOFT Project), Madrid (Spain), 8-11 May 1990). Order Number DE90012957. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The purpose of this paper is to review the evidence from the OECD LP-FP-2 experiment that a high temperature excursion occurred within the center fuel module (CFM) during the reflood portion of the test, was caused by rapid metal-water reaction. It is shown that this reflood scenario explains many perplexing observations from the experiment, in particular, the small amount of fission products and hydrogen transported to the blowdown suppression tank (BST) as compared with the larger quantities trapped within the primary coolant system (PCS). The timing and destruction of the CFM upper tie plate, as well as the transport of fuel debris to the top of this plate, are also explained. In general, all measurements, observations, and analyses of the LP-FP-2 data indicate that most of the CFM damage occurred during a relatively short period of time coincident with the reflood portion of the experiment. 4 refs., 6 figs.

36972 (KFK–4693) **Preclinical diagnosis and emergency medical care in case of radiation accidents.** Ohlenschlaeger, L. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Medizinische Abt. Jan 1990. 25p. (In German). Order Number DE90501263. Available from NTIS (US Sales Only), PC A03/MF A01.

Reference is made to preclinical diagnosis and emergency medical care at the site of a potential radiation accident. Possibilities and limits, respectively, of the medical measures are shown. Cooperation between the experts of the technical and medical rescue services is described. Exposition to radiation for the emergency medical staff resulting from the medical care of contaminated persons, is negligible if the personal precautions are observed. (orig.).

36973 (NUREG–0837-Vol.10-No.1) **NRC TLD [thermoluminescent dosimeter] Direct Radiation Monitoring Network: Progress report, January–March 1990: Volume 10, No. 1.** Struckmeyer, R.; McNamara, N. Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I. Jun 1990. 222p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A10/MF A01 - GPO; OSTI; INIS.

The US Nuclear Regulatory Commission (NRC) Direct Radiation Monitoring Network is operated by the NRC in cooperation with participating states to provide continuous measurement of the ambient radiation levels around licensed NRC facilities, primarily power reactors. Ambient radiation levels result from naturally occurring radionuclides present in the soil, cosmic radiation constantly bombarding the earth from outer space, and the contribution, if any, from the monitored facilities and other man-made sources. The Network is intended to measure radiation levels during routine facility operations and to establish background radiation levels used to assess the radiological impact of an usual condition, such as an accident. This report presents the radiation levels measured around all facilities in the Network for the first quarter of 1990. A complete listing of the site facilities monitored is included. In some instances, two power reactor facilities are monitored by the same set of dosimeters.

36974 (NUREG–1352) **Action plans for motor-operated valves and check valves.** Scarbrough, T.G. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology. Jun 1990. 27p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO; OSTI; INIS.

The proper performance of motor-operated valves (MOVs) and check valves is necessary for the safety operation of a nuclear power plant. Problems have been experienced, however, with these valves for many years. Currently, the US Nuclear Regulatory Commission (NRC) and the nuclear industry have a number of activities under way to provide assurance that MOVs and check valves will successfully perform their safety functions when needed. The Mechanical Engineering Branch (EMEB) of the NRC Office of Nuclear Reactor Regulation has been assigned the responsibility of coordinating NRC activities and monitoring industry activities regarding MOVs and check valves. To meet this responsibility, EMEB has prepared action plans to provide assurance of the proper performance of these valves. Among the staff activities described in the action plans is the consideration of the need to revise the regulations to clarify the inservice testing (IST) requirements for these valves. The need for regulatory guidance for the development of acceptable IST programs, as well as for other licensee activities relating to the performance of MOVs and check valves, will also be evaluated. In addition, NRC personnel will have to verify, in a consistent manner, implementation of licensee commitments in response to NRC generic letters and bulletins. Another important aspect of the action plans is the provision for the NRC staff to provide assistance, where appropriate, to the industry in its efforts to address MOV and check valve issues. Finally, the action plans include a tentative schedule for accomplishing the described staff activities.

36975 (NUREG–1410) **Loss of vital ac power and the residual heat removal system during mid-loop operations at Vogtle Unit 1 on March 20, 1990.** Nuclear Regulatory Commission, Washington, DC (USA). Jun 1990. 516p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A22/MF A01 - GPO; OSTI; INIS.

On March 20, 1990, the Vogtle Electric Generating Plant Unit 1, located in Burke County, Georgia, about 25 miles southeast of Augusta, experienced a loss of all safety (vital) ac power. The plant was in cold shutdown with reactor coolant level lowered to "mid-loop" for various maintenance tasks. Both the containment building personnel hatch and equipment hatch were open. One emergency diesel generator and one reserve auxiliary transformer were out of service for maintenance, with the remaining reserve auxiliary transformer supplying both Unit 1 safety buses. A truck in the low voltage switchyard backed into the support column for an offsite power feed to the reserve auxiliary transformer which was supplying safety power. The insulator broke, a phase-to-ground fault occurred, and the feeder circuit breakers for the safety buses opened. The operable emergency diesel generator started automatically because of the undervoltage condition on the safety bus, but tripped off after about 1 minute. About 20 minutes later the diesel generator load sequencer was reset, causing the diesel generator to start a second time. The diesel generator operated for about 1 minute, and tripped off. The diesel generator was restarted in the manual emergency mode 36 minutes after the loss of power. The generator remained on line and provided power to its safety bus. During the 36 minutes without safety bus power, the reactor coolant system temperature rose from about 90 °F to 136 °F. This report documents the results of an Incident Investigation Team sent to Vogtle by the Executive Director for Operations of the US Nuclear Regulatory Commission to determine what happened, identify the probable causes, and make appropriate findings and conclusions. 79 figs., 16 tabs.

36976 (NUREG/CP–0095, pp. 47-56) **Filtered containment venting systems for Swiss LWR's - proposed design requirements and principles.** Gilli, R. (Swiss Federal Nuclear Safety Inspectorate, Wuerenlingen (Switzerland)); Prohaska, G.; Gubler, R. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Standards; Sandia National Labs., Albuquerque, NM (USA). Nov 1988. (SAND–88-1836;CONF-880616–: 4. workshop on integrity of containments for nuclear power plants, Arlington, VA (USA), 14-17 Jun 1988). In *Fourth workshop on containment integrity. Proceedings.* Order Number DE89004641. Available from NTIS, PC A99/MF A01 - I.

NPPs in Switzerland will initiate installation of Filtered Containment Venting Systems (FCVS) beginning in 1990. The proposed design requirements and principles for FCVS have been formulated based on specific classes of severe accident scenarios and taking into account the four different containment types of the NPPs in operation. In these accident scenarios, FCVS can prevent containment failure due to internal pressure buildup, and the amount of released radioactive material can be effectively reduced. The paper summarizes, related to FCVS, the important features of the four different containment types of Swiss LWR's. The severe accident scenarios relevant to FCVS and the corner stones of the proposed design requirements are outlined. In addition, other design parameters to be considered for FCVS are listed.

36977 (NUREG/CP–0095, pp. 57-76) **Filtered vented containments.** Schlueter, R.O. (Bechtel Power Corporation, San Francisco, CA (USA)); Schmitz, R.P. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Standards; Sandia National Labs., Albuquerque, NM (USA). Nov 1988. (SAND–88-1836;CONF-880616–: 4. workshop on integrity of containments for nuclear power plants, Arlington, VA (USA), 14-17 Jun 1988). In *Fourth workshop on containment integrity. Proceedings.* Order Number DE89004641. Available from NTIS, PC A99/MF A01 - I.

Adding Filtered Vented Containment System (FVCS) to an existing nuclear power plant has been suggested as one approach to mitigating the effects of a Severe Accident. The integration of a new system into a plant appears simple on the surface but may be expensive to install and complex in developing operating procedures and restrictions. A number of designs have been proposed and many are currently being installed at European nuclear facilities. Risk assessments and cost benefits for an FVCS installation in a typical U.S. plant are discussed. An approach to developing an FVCS and strategies for system operation (venting) is also included along with a conceptual design of a sand/gravel filter system. Estimated installed costs are included.

36978 (NUREG/CP–0095, pp. 275-290) **Leak rate test of containment personnel lock.** Julien, J.T. (CBI Research Corporation, Plainfield, IL (USA)); Peters, S.W. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Standards; Sandia National Labs., Albuquerque, NM (USA). Nov 1988. (SAND–88-1836;CONF-880616–: 4. workshop on integrity of containments for nuclear power plants, Arlington, VA (USA), 14-17 Jun 1988). In *Fourth workshop on containment integrity. Proceedings.* Order Number DE89004641. Available from NTIS, PC A99/MF A01 - I.

As part of the US NRC Containment Integrity Program, a leak rate test was performed on a full size personnel airlock for a nuclear containment building. The airlock was subjected to conditions simulating severe accident conditions. The objective of the test was to characterize the performance of airlock door seals when subjected to conditions that exceeded design. The seals tested were a double dog-ear configuration and made from EPDM E603. The data obtained from this test will be used by SNL as a benchmark for development of analytical methods. In addition to leak rate information, strain, temperature, displacements, and pressure data were measured and recorded from over 330 transducers. The test lasted approximately 60 hours. Data were recorded at regular intervals and during heating, pressurization and depressurization. The inner airlock door and bulkhead were exposed to a maximum air temperature of 850 F and a maximum air pressure of 300 psig. The airlock was originally designed for 340 F and 60 psig. Two heating and pressurization cycles were planned; one to heat to 400 F and pressurize to 300 psig, and the second to heat to 800 F and pressurize to 300 psig. No significant leakage was recorded during these two cycles. A third cycle was added to the test program. The air temperature was increased to 850 F and held at this temperature for approximately 10 hours. The inner door seal failed quickly at a pressure of 150.5 psig. The maximum leak rate was 706 SCFM.

36979 (NUREG/CR–4525) **Closeout of IE Bulletin 84-03: Refueling cavity water seal: Final report.** Foley, W.J. (Parameter, Inc., Elm Grove, WI (USA)); Dean, R.S.; Hennick, A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Operational Assessment; Parameter, Inc., Elm Grove, WI (USA). Jun 1990. 75p. Sponsored by Nuclear Regulatory Commission. (PARAMETER/IE–155). Available from NTIS, PC A04/MF A01 - GPO; OSTI; INIS.

Documentation is provided in this report to close IE Bulletin 84-03 on the subject of refueling cavity water seals. The bulletin was issued on August 24, 1984, to all power reactor facilities except Fort St. Vrain. Because the excluded plant is gas-cooled and graphite-moderated, the subject of the bulletin does not apply to that plant. The event causing the safety concern was failure of the pneumatic seals containing water in the refueling cavity at Haddam Neck on August 21, 1984. The cavity had been flooded in preparation for refueling, but when the seals failed, water level decreased from full level just below the operating floor down to the level of the reactor vessel flange. On May 17, 1988, another refueling cavity seal leakage (about three feet in water level) occurred at Surry 1, which was in the middle of a refueling and maintenance outage. Evaluation of utility responses and NRC/Region inspection reports in accordance with a specific criterion shows that the bulletin is closed for 114 (97%) of the 118 affected facilities. It is concluded that the concerns of the bulletin have been resolved through design and procedure reviews and corrective actions taken by licensees. Follow-up items are proposed for use by NRC Region II in closing the bulletin for the four (4) remaining facilities with open bulletin status. NRC Region II verifies that are the bulletin will not be closed for these four TVA facilities until construction is completed. Background information is supplied in the Introduction and Appendix A.

36980 (NUREG/CR–5111) **Integrated Reliability and Risk Analysis System (IRRAS) Version 2.0 user's guide.** Russell, K.D. (EG and G Idaho, Inc., Idaho Falls, ID (USA)); Sattison, M.B.; Rasmuson, D.M. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; EG and G Idaho, Inc., Idaho Falls, ID (USA). Jun 1990. 463p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC07-76ID01570. (EGG–2535). Available from NTIS, PC A20/MF A01 - GPO; OSTI; INIS.

The Integrated Reliability and Risk Analysis System (IRRAS) is a state-of-the-art, microcomputer-based probabilistic risk assessment (PRA) model development and analysis tool to address key nuclear plant safety issues. IRRAS is an integrated software tool that gives the user the ability to create and analyze fault trees and accident sequences using a microcomputer. This program provides functions that range from graphical fault tree construction to cut set generation and quantification. Also provided in the system is an integrated full-screen editor for use when interfacing with remote mainframe computer systems. Version 1.0 of the IRRAS program was released in February of 1987. Since that time, many user comments and enhancements have been incorporated into the program providing a much more powerful and user-friendly system. This version has been designated IRRAS 2.0 and is the subject of this user's guide. Version 2.0 of IRRAS provides all of the same capabilities as Version 1.0 and adds a relational data base facility for managing the data, improved functionality, and improved algorithm performance. 9 refs., 292 figs., 4 tabs.

36981 (NUREG/IA–0011) **TRAC-PF1 MOD1 post test calculations of the OECD LOFT Experiment LP-SB-1.** Allen, E.J. (UKAEA Atomic Energy Establishment, Winfrith (UK)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; UKAEA Atomic Energy Establishment, Winfrith (UK). Apr 1990. 127p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC E07/MF E01 - GPO; OSTI; INIS.

This report contains 1 microfiche supplement.

Analysis of the small, hot leg break, OECD LOFT Experiment LP-SB-1. using the "best-estimate" computer code TRAC-PF1/MOD1 is presented. Descriptions of the LOFT facility and the LP-SB-1 experiment are given and development of the TRAC-PF1/MOD1 input model is detailed. The calculations performed in achieving the steady state conditions, from which the experiment was initiated, and the specification of experimental boundary conditions are outlined. 24 refs., 66 figs., 12 tabs.

36982 (NUREG/IA–0022) **TRAC-PF1/MOD1 post-test calculations of the OECD LOFT Experiment LP-SB-3.** Allen, E.J. (UKAEA Atomic Energy Establishment, Winfrith (UK)); Neill, A.P. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; UKAEA Atomic Energy Establishment, Winfrith (UK). Apr 1990. 93p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC E05/MF E01 - GPO - OSTI.

This report contains 2 microfiche supplements.

Analysis of the small, cold leg break, OECD LOFT Experiment LP-SB-3 using the best-estimate computer code TRAC-PF1/MOD1 is presented. Descriptions of the LOFT facility and the LP-SB-3 experiment are given and development of the TRAC-PF1/MOD1 input model is detailed. The calculations performed in achieving the steady state conditions, from which the experiment was initiated, and the specification of experimental boundary conditions are outlined. Results of the TRAC-PF1/MOD1 calculation are found to be generally consistent with those reported, by members of the OECD LOFT Program Review Group, in the LP-SB-3 "Comparison Report." Overall trends with respect to pressure histories, minimum primary system mass inventory and accumulator behaviour are reasonably well reproduced by TRAC-PF1/MOD1. 17 refs., 26 figs., 3 tabs.

36983 (OECD/LOFT-T–3907) **An account of the OECD LOFT [Organization for Economic Cooperation and Development Loss-of-Fluid] Project.** Fell, J. (UKAEA Headquarters, London (UK)); Modro, S.M. EG and G Idaho, Inc., Idaho Falls, ID (USA). May 1990. 115p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE90013022. Available from NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

This report sets out the history and records the significant technical findings of a particularly important international collaboration on nuclear reactor safety, the OECD LOFT Project, in which a number of OECD countries, organized through the NEA, collaborated on a program to use of the LOFT (Loss-of Fluid Test) experimental nuclear test facility at the Idaho National Engineering Laboratory (INEL) in a program of safety experiments. The initial proposal was developed from an initiative of the United States Department of Energy, who also provided continuing management support. The objective of an international team with those of the reactor operation and analysis staff at INEL to provide a significant addition both to the international database of large-scale experimental data on reactor safety and to the analysis and understanding of the test results. 51 refs., 15 figs., 11 tabs.

36984 (OECD/LOFT-T–3908) **An account of the OECD LOFT [Organization for Economic Cooperation and Development Loss of Fluid Test] Project: Executive summary.** EG and G Idaho, Inc., Idaho Falls, ID (USA). May 1990. 12p. Sponsored by

U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE90012392. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report sets on record a Nuclear Energy Agency-Organization for Economic Cooperation and Development (NEA-OECD) initiative, following a proposal by the US authorities to set up and manage a major international project which would extend both the lifetime and scope of the US Department of Energy (USDOE) Loss of Fluid Test (LOFT) integral test facility at the Idaho National Laboratory (INEL) in Idaho, USA. The test program of 8 experiments, which extended from 1983 to 1989 followed a US Nuclear Regulatory Commission (USNRC) program of 36 experiments over the period 1976 to 1982. The information from the OECD program has been made fully available to the international community both in the form of detailed technical reports and as a computer database containing all the quantitative experimental information, held both at the NEA Paris and at the INEL in Idaho. This account of the OECD LOFT Project briefly summarizes this mass of technical information. 2 figs.

36985 (ORNL/FTR–2916) **[Advanced technologies for water-cooled reactors]: Foreign trip report, May 24–June 12, 1988.** Forsberg, C.W. Oak Ridge National Lab., TN (USA). 12 Jul 1988. 34p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90012276. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The travelers participated in multiple IAEA meetings on fuel improvements and advanced technologies for light water reactors. The meeting in Vienna was a planning meeting to determine what should be done in an Agency-proposed study of many possible improvements to LWR fuel to improve its economics, reliability, and uranium utilization. The scope of reasonable improvements to be studied as recommended by the advisors was much smaller than Agency expectations; our future participation in this study may need to be re-examined after the Agency decides precisely what it hopes to accomplish. The travelers then participated in multiple International Atomic Energy Agency (IAEA) meetings on technologies for water-cooled reactors. At the Technical Committee Meeting, the travelers presented papers and worked with the committee to develop internationally agreed upon definitions and understandings of safety terms for advanced reactors. At the International Working Group Meeting, the travelers worked with the group to plan future IAEA meetings on advanced water-cooled reactor technology. The meetings provided information of the direction and scope of foreign advanced and developmental water-cooled reactor research programs. In particular, a better understanding of the programs in Sweden, Canada, Italy, and Japan was obtained. Work in Canada at Chalk River on a developmental Candu reactor work may be applicable in the United States for a developmental light-water reactor.

36986 (ORNL/FTR–3101) **[Thermal reactor safety]: Foreign trip report, October 2–13, 1988.** Osborne, M.F. Oak Ridge National Lab., TN (USA). 7 Nov 1988. 17p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. Order Number DE90012274. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler attended the international meeting on reactor safety, which included 24 technical sessions, a special panel session, and four poster sessions, in addition to formal opening and closing sessions. The traveler presented ORNL work in a poster session; interest in this work was indicated by extensive inspection and detailed discussion with visitors from many countries, especially France, Canada, and Japan. Highlights of the most relevant papers and discussions are summarized. The subsequent laboratory visits provided further opportunities to inspect experimental facilities and to discuss, in detail, the experimental techniques and results. The main impressions of these visits are summarized, and the benefits to ORNL and NRC programs are discussed.

36987 (SAND–89-3029C) **Recent developments in the CONTAIN-LMR code.** Murata, K.K. Sandia National Labs., Albuquerque, NM (USA). [1990]. 18p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-900804–29: International topical meeting on fast reactor safety, Snowbird, UT (USA), 12-16 Aug 1990). Order Number DE90012184. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Through an international collaborative effort, a special version of the CONTAIN code is being developed for integrated mechanistic analysis of the conditions in liquid metal reactor (LMR) containments during severe accidents. The capabilities of the most recent code version, CONTAIN LMR/1B-Mod.1, are discussed. These include new models for the treatment of two condensables, sodium condensation on aerosols, chemical reactions, hygroscopic aerosols, and concrete outgassing. This code version also incorporates all of the previously released LMR model enhancements. The results of an integral demonstration calculation of a sever core-melt accident scenario are given to illustrate the features of this code version. 11 refs., 7 figs., 1 tab.

36988 (SGCISN–8940) **The nuclear safety in France, in 1988.** CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. Aug 1988. 91p. (In French). Order Number DE90500787. Available from NTIS (US Sales Only), PC A05/MF A01.

In the scope of the nuclear safety program, in France, a state of the art of the projects on the 1st August 1988, is given. The different domains related to the nuclear safety are summarized. The purposes, the actions and the available means of the nuclear safety interministerial committee, are examined. The problems concerning the radiation protection of the personnel and reactor components, the application of the regulations and the nuclear materials management, are also examined. In the case of a nuclear accident, the protection operations depend on the responsibilities and on the different fields of action. In the world scale, the international cooperation and the example of the Tchernobyl accident are of relevant importance.

36989 (WHC-SA–0814) **Analysis of Beyond Design Basis Events for the Fast Flux Test Facility UO_2 core.** Padilla, A. Jr.; Harris, R.A.; Knutson, B.J. Westinghouse Hanford Co., Richland, WA (USA). Apr 1990. 15p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. (CONF-900804–14: International topical meeting on fast reactor safety, Snowbird, UT (USA), 12-16 Aug 1990). Order Number DE90010855. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An analysis of two Beyond Design Basis Events (transient overpower without scram and loss of flow without scram) was performed for the proposed UO_2 core design in the Fast Flux Test Facility using the SASSYS/SAS4A accident analysis computer code. Numerical results are presented for two different cases: with and without the reactivity feedbacks for core and structure movement (core radial expansion, assembly duct bowing, control rod driveline expansion, and fuel axial expansion). When all of the reactivity feedbacks are included, no sodium boiling or fuel failure is predicted. When the reactivity feedbacks for core and structure movement are neglected, sodium boiling and fuel failure are predicted, but the amount of core damage is substantially lower compared to previous analyses for the initial mixed oxide core. 6 refs., 10 figs., 1 tab.

36990 Transactions of the 10th international conference on structural mechanics in reactor technology. Volume G. Fracture mechanics and non-destructive evaluation. Hadjian, A.H. (Bechtel Power Corp., Los Angeles, CA (USA)). 375p. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This book contains the transactions of an international conference on structural mechanics in reactor technology. Topic covered include: three-dimensional cracks, crack growth and stability, creep crack growth, and computational fracture mechanics.

36991 Transactions of the 10th international conference on structural mechanics in reactor technology. Volume A. Principal division lectures. Hadjian, A.H. (Bechtel Power Corp., Los Angeles, CA (USA)). 404p. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in

Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

This book contains the transactions of the 10th international conference on structural mechanics in reactor technology. Topics include: advances in computational mechanics; development in fracture mechanics and non-destructive examination; and short-term degradation mechanisms of piping.

36992 A summary of microbial influenced corrosion in nuclear power plants. Wolfram, J.H. (Idaho National Engineering Lab., Idaho Falls, ID (USA)); Rogers, R.D.; Buescher, B.J. pp. 61-70 of Life extension and assessment: Nuclear and fossil power-plant components. Jaske, C.E.; Shah, V.N.; Sinnappan, J.; Meligi, A.E.; Narayanan, T.V.; Bond, C.B. American Society of Mechanical Engineers, New York, NY (USA) (1988). (CONF-880661–: ASME pressure vessel and piping conference, Pittsburgh, PA (USA), 19-23 Jun 1988).

A summary of microbial induced corrosion (MIC) is presented. Occurrences of this type of corrosion in nuclear power generating plants systems are cited. Both safety and nonsafety systems have been attacked by MIC. This phenomena is discussed in relation to the potential effects it could have in the overall aging of the plant. Microbial involvement, types of metals affected and mitigation and prevention of MIC are also covered.

36993 Aging considerations for pressurizers in nuclear power plants. Ware, A.G. (Idaho National Engineering Lab., Idaho Falls, ID (USA)). pp. 1-12 of Life extension and assessment: Nuclear and fossil power-plant components. Jaske, C.E.; Shah, V.N.; Sinnappan, J.; Meligi, A.E.; Narayanan, T.V.; Bond, C.B. American Society of Mechanical Engineers, New York, NY (USA) (1988). DOE Contract AC07-76ID01570. (CONF-880661–: ASME pressure vessel and piping conference, Pittsburgh, PA (USA), 19-23 Jun 1988).

This paper discusses the degradation mechanisms affecting the residual life of the nuclear pressurized water reactor (PWR) pressurizer and its subcomponents. The major sources of degradation for pressurizers are thermal transients such as plant heatups and cooldowns, internal pressure within the vessel, high intermittent flow through the spray nozzle, differential thermal movement causing rubbing of the immersion heater sheathes, and prolonged exposure to chemical and thermal conditions that can potentially lead to degradation. The latter includes thermal embrittlement of cast stainless steel spray heads and chemically assisted intergranular stress corrosion cracking of stainless steel. Steam leakage that interacts with lubricants used to assemble manway bolted joints can cause corrosion of bolts.

36994 Fatigue degradation of nozzles and piping in a PWR reactor coolant system. Siegel, E.A. (Combustion Engineering, Inc., Windsor, CT (USA)). pp. 13-20 of Life extension and assessment: Nuclear and fossil power-plant components. Jaske, C.E.; Shah, V.N.; Sinnappan, J.; Meligi, A.E.; Narayanan, T.V.; Bond, C.B. American Society of Mechanical Engineers, New York, NY (USA) (1988). (CONF-880661–: ASME pressure vessel and piping conference, Pittsburgh, PA (USA), 19-23 Jun 1988).

As part of a residual life assessment program for pressurized water reactor (PWR) systems, age related degradation may have a significant impact on certain components other than the major reactor coolant system (RCS) components. The components and their potential for fatigue related degradation are generally common to the three major PWR NSSS designs, and involve local thermal transient characteristics that can be more severe than those acting on the major RCS components. Previous studies form the basis for this data. These components include the pressurizer spray and surge lines and nozzles, the steam generator feedwater nozzles, the safety injection nozzles, and the charging inlet nozzles. This paper describes the system characteristics which can lead to fatigue degradation for these critical locations in the RCS. Recommendations for evaluating, monitoring, and inspecting each of these locations are also provided. Current evaluation data developed by CE for the pressurizer spray piping are also discussed.

36995 Wide-plate crack-arrest tests utilizing prototypical and degraded (simulated) pressure vessel steels. Naus, D.J. (Oak Ridge National Lab., TN (USA)); Keeney-Walker, J.; Boss, B.R.; Fields, R.J.; deWit, R.; Low, S.R. III. pp. 109-118 of Transactions of the 10th international conference on structural mechanics in reactor technology. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). DOE Contract AC05-84OR21400. (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

Sixteen wide-plate crack-arrest tests have been completed, ten utilizing specimens fabricated from A533B class 1 material and six fabricated from a low-upper-shelf base material. Each test utilized a single-edge notched specimen that was subjected to a linear thermal gradient along the plane of crack propagation. Test results exhibit an increase in crack-arrest toughness (K_{Ia}) with temperature, with the rate of increase becoming greater as the temperature increases. When the wide-plate test results are compared with other large-specimen results, that data show a consistent trend in which the K_{IA} data extend above the limit provided in ASME Section XI.

36996 Advances on the analysis of fast reactor core and coolant circuit structures. Livolant, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)); Imazu, A.; Chang, Y.W.; Eggen, D.T. pp. 155-184 of Transactions of the 10th international conference on structural mechanics in reactor technology. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

For the 10th SMiRT Conference, it has been decided to make general reviews of the accomplishments throughout the conferences. The aim of this paper is to make such a review in the field of fast reactor core and coolant circuit structures, which is now fully treated in division E. That was not true in the past: at the earliest conferences up to the 5th, the division E dealt with accidental studies among which the hypothetical core disruptive accident was the most important. So, to cover the subject from the first SMiRT to now, it has been necessary to search into all the past division in order to recover the studies fitting into the scope of the present division E. This has allowed a table showing the number of presented papers on the various topics at the SMiRT conferences to be set up (table I). Then, some significant topics have been studied in detail, highlighting the main accomplishments, but trying also to point out the shortcomings and the work still to be done, in view of the present state of art.

36997 Advancements in the behavioral modeling of fuel elements and related structures. Billone, M.C. (Argonne National Lab., IL (USA)); Montgomery, R.O.; Rashid, Y.R.; Head, J.L. pp. 105-126 of Transactions of the 10th international conference on structural mechanics in reactor technology. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

An important aspect of the design and analysis of nuclear reactors is the ability to predict the behavior of fuel elements in the adverse environment of a reactor system. By understanding the thermomechanical behavior of the different materials which constitute a nuclear fuel element, analysis and predictions can be made regarding the integrity and reliability of fuel element designs. The SMiRT conference series, through the division on fuel elements and the post-conference seminars on fuel element modeling, provided technical forums for the international participation in the exchange of knowledge concerning the thermomechanical modeling of fuel elements. This paper discusses the technical advances in the behavioral modeling of fuel elements presented at the SMiRT conference series since its inception in 1971. Progress in the areas of material properties and constitutive relationships, modeling methodologies, and integral modeling approaches was reviewed and is summarized in light of their impact on the thermomechanical modeling of nuclear fuel elements.

24 POWER TRANSMISSION AND DISTRIBUTION

Refer also to citation(s) 37021

2402 Power System Networks, Transmission and Distribution

Refer also to citation(s) 36999

36998 (EPRI-EL–6849) **Direct embedment foundation research: Load test summaries: Final report.** DiGioia, A.M. Jr. (GAI Consultants, Inc., Monroeville, PA (USA)); Rojas-Gonzalez, L.F.; Yourd, D.A. Electric Power Research Inst., Palo Alto, CA (USA); GAI Consultants, Inc., Monroeville, PA (USA). ©Jun 1990. 345p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This project involved the development of a design/analysis model for direct embedment foundations subject to high overturning moments and moderate compressive axial and lateral forces. The final report discusses the semiempirical model developed by modifying the "four-spring nonlinear subgrade modulus" model for laterally loaded drilled shaft foundations previously developed for EPRI. The design/analysis model for direct embedment foundations considers the stiffness of the pole, the multilayer soil system, and the annulus backfill to estimate deflections and rotations. The model also considers the influence of the backfill in the resistance to the applied loads. The model has been incorporated in the EPRI computer program MFAD (Moment Foundation Analysis and Design) contained in TLWorkstation, which is now capable of analyzing/designing laterally loaded drilled shafts and direct embedment foundations. The final report also presents comparisons between model predictions of load-deflection/rotation behavior and the actual behavior observed in twelve full-scale load tests. This supplemental volume was prepared to document data gathered from the twelve full-scale laterally loaded direct embedment foundation tests conducted during the project.

2403 Power Transmission Lines and Cables

Refer also to citation(s) 37685

36999 (WAST–90012584) **138-kV six-phase Charleroi-Yukon Line uprating study for Allegheny Power Service Corporation.** Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Dept. 29 Jun 1982. 287p. Available from OSTI; Westinghouse Electric Corporation, Research and Development Department, Advanced Systems Technology, Pittsburgh, PA 15235.

Results of a one-year study of the terminal equipment design and costs for two transmission alternatives for uprating Allegheny Power Service Corporation's 138-kV Charleroi-Yukon Line are presented. The two transmission line uprating alternatives were (1) a 138-kV six-phase line, and (2) a 230-kV three-phase double-circuit line of comparable power transfer capability. Transformers, circuit breakers, arresters, relay protection equipment, and transmission line voltage uprating requirements were investigated. Preliminary designs were developed for new equipment suitable for 138-kV six-phase operation. The line termination equipment designs and costs for the two transmission uprating alternatives presented in this report may be used with other Allegheny Power Service Corporation studies to evaluate their effectiveness as viable transmission system elements in future APS system designs.

2404 Health and Safety

Refer also to citation(s) 37683, 37684

25 ENERGY STORAGE

Refer also to citation(s) 37021

2501 Magnetic

Refer also to citation(s) 38258

2506 Thermal

37000 (ORNL/Sub–86-7685/2) **Boiling/evaporative heat transfer from spheres in packed-bed thermal energy storage units: Final report.** Arimilli, R.V. (Tennessee Univ., Knoxville, TN (USA). Dept. of Mechanical and Aerospace Engineering); Moy, C.A. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Dept. of Mechanical and Aerospace Engineering. May 1990. 88p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90012023. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

An experimental study was conducted to study boiling/evaporative heat transfer from heated spheres in vertical packed beds with downward liquid vapor flow of Refrigerant-113. Surface superheats of 1 to 50°C; mass flow rates of 1.7, 2.7, and 5.6 kg/min; sphere diameters of 1.59 and 2.54 cm; quality (i.e., mass fraction of vapor) of the inlet flow of 2 to 100%; and two surface roughness conditions were considered. To determine heat transfer coefficients, smooth and roughened aluminum spheres of the same diameter as the other spheres in the bed were instrumented with two thermocouples each for measuring the surface temperatures and a tiny electrical resistance heater for input power. The heat transfer measurements were made under steady-state conditions. Heat transfer coefficients were independently determined for each sphere at three values of surface superheat. The quantitative results are represented a a correlation for the boiling heat transfer coefficients in terms of a homogeneous model. The equation correlates very effectively with the dimensionless temperature difference. The correlation may be used in the development of numerical models to simulate the transient thermal performance of a packed-bed thermal energy storage unit while operating as an evaporator. The boiling of the liquid vapor flow around the spheres in the packed bed was visually observed with a fiber optic boroscope and recorded on a video tape. The visualization results showed qualitatively the presence of our four distinct flow regimes. One of these occurs under subcooled regime. The other three occur under saturated inlet conditions and are referred to as the low-quality, medium-quality, and high-quality regimes. The regimes are discussed in detail.

37001 (ORNL/TM–11511) **Commercial cool storage laboratory test procedure.** Stovall, T.K.; Tomlinson, J.J. Oak Ridge National Lab., TN (USA). Jun 1990. 70p. Sponsored by Electric Power Research Institute. DOE Contract AC05-84OR21400. Order Number DE90011279. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Many utilities have identified cool storage in commercial buildings as one of their most attractive load-management options. Widespread adoption of this technology can be enhanced by greater certainty about the performance of cool storage systems and the resolution of relevant technical issues. To address these issues, cool storage equipment manufacturers, architects, designers, and engineers experienced in cool storage implementation recommended a program of laboratory testing to identify design deficiencies, document performance, and provide improved cool storage installation and design guidelines. The Ice Storage Test Facility was designed to address these issues through a thorough testing program independent of the manufacturers. Test procedures presented in this document are aimed at answering all out-standing performance issues. 1 ref., 15 figs., 5 tabs.

2508 Chemical

Refer also to citation(s) 37002

2509 Batteries

Refer also to citation(s) 36844

37002 (SAND–90-1139C) **The development and characterization of ion exchange membranes for selected electrochemical power sources.** Arnold, C. Jr.; Assink, R.A. Sandia National Labs., Albuquerque, NM (USA). [1990]. 3p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-900892–1: ICOM '90: international congress on membranes and membrane processes, Chicago, IL (USA), 20-24 Aug 1990). Order Number DE90009741. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Short communication. MEMBRANES/electric conductivity; MEMBRANES; ELECTROCHEMISTRY; ION EXCHANGE; POROSITY; ELECTROLYTES; ELECTRIC BATTERIES; IRON CHLORIDES; POWER SUPPLIES

37003 Composite polyphase electrochemical cell components. Crouch-Baker, S. (Dept. of Materials Science and Engineering, Stanford Univ., Stanford, CA (US)); Huggins, R.A. pp. 177-187 of Solid state ionics. Nazri, G.; Huggins, R.A.; Shriver, D.F. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-8811221–: Solid state ionics, Boston, MA (USA), 28 Nov - 2 dec 1988).

A number of composite polyphase electrode systems employing the mixed-conducting matrix principle have been proposed as alternatives to single lithium alloy systems for use as negative electrodes in both room and intermediate temperature lithium-based cells. Further, a composite hydroxide ion conducting electrolyte has been considered for use at intermediate temperatures which utilizes liquid lithium hydroxide formed in situ and contained within a lithium aluminium oxide ceramic matrix. Both these, and other, composite electrochemical cell component systems serve to overcome certain disadvantages found in simpler, non-composite designs. In order to operate effectively, the electrode and electrolyte systems described here must satisfy certain thermodynamic, kinetic and mechanical criteria. In this work, these criteria are discussed, using, among others, the examples given above, with particular emphasis on the thermodynamic phase stability conditions which must be satisfied by a viable composite electrode or electrolyte system.

29 ENERGY PLANNING AND POLICY

37004 (DOE/EIA–0149(77-89)) **EIA Publications Directory, 1977–1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of the National Energy Information System. 1 Jun 1990. 398p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE90012418. Available from NTIS, PC A18/MF A01 - GPO - OSTI; GPO Dep.

Enacted in 1977, the Department of Energy (DOE) Organization Act established the Energy Information Administration (EIA) as the Department's independent statistical and analytical agency, with a mandate to collect and publish data and prepare analyses on energy production, consumption, prices, and resources, and projections of energy supply and demand. This cumulative edition of the EIA Publications Directory (formerly entitled EIA Publications Directory: A User's Guide) contains titles and abstracts of periodicals and one-time reports produced by the EIA from October 1977 through December 1989. It supersedes all previous issues of the Directory. EIA publications have undergone a great many changes over the last decade. The EIA inherited periodicals from the Bureau of Mines, Federal Power Commission, and the Federal Energy Administration. Some of these periodicals have been retitled, consolidated, or discontinued. These changes are noted in the abstracts. The body of the Directory contains citations and abstracts arranged by broad subject categories, such as coal, petroleum, and natural gas and subcategories such as reserves, products and byproducts, and marketing and economics. All reports are indexed alphabetically by subject and title and numerically by report number. EIA appreciates the assistance of DOE's Office of Scientific and Technical Information in sharing portions of the Energy Data Base.

2901 Energy Analysis and Modeling

Refer also to citation(s) 37132

37005 (DLR-Mitt.–89-21) **Solar energy and hydrogen - for qualitative growth.** Winter, C.J. (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt e.V. (DLR), Stuttgart (Germany, F.R.). Forschungsbereich Energetik). Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.). 1989. 44p. (In German). Order Number DE90501149. Available from NTIS (US Sales Only), PC A03/MF A01.

Reports of the deliberate destruction of the environment have become increasingly alarming, and the existing fossil and nuclear energy systems are partly responsible for this development. For the first time in the history of energy supply starting from the beginning of industrialization, mankind now has the opportunity to add to the existing open, exhaustible and polluting energy systems a more or less non-polluting, constantly self-regenerating cyclic energy system. Qualitative growth becomes possible without having to halt an ever-increasing energy demand. Conservative energy utilization, indigenous solar energy application and solar hydrogen contribute to autonomous growth, largely without causing defensive or compensatory costs. (orig.) With 17 refs., 6 figs.

37006 (PIRSEM–2099-1) **Follow-up of the regional energy conservation politics. Methods and illustration with the case of Charente-Poitou.** Guesnier, B.; Trousslot, F.; Debord, J.; Carriere, J.P. Centre National de la Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matiernes Premieres (PRISEM); Poitiers Univ., 86 (France). 1987. 100p. (In French). Order Number DE90501025. Available from NTIS (US Sales Only), PC A05/MF A01.

The objective of this study was to develop a follow-up method for the energy conservation planning in a region in France. The first goal is to improve the energy balance in France but many other goals are introduced in the new approach: effects on the local employment rate, budgets, integration to the industrial and domestic infrastructure, etc. Various index and criterions are introduced to allow a global perception and accountancy of the effects of energy conservation expenses on the regional development and balance. Application of the method is illustrated by the example of the Charentes-Poitou region.

37007 (PIRSEM–3130) **Adaptation and experimentation of management and physical economy models to the problems of the regional energy planning.** Valette, F. Centre National de la Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matiernes Premieres (PRISEM). 1987. 74p. (In French). Order Number DE90501023. Available from NTIS (US Sales Only), PC A04/MF A01.

The objective of the study was to determine the main lines of a global procedure approach for regional planification of energy. The approach is based on different energy and economic models already adapted, and on a large debating procedure among the region, in order to improve the conditions when preparing and planning the regional development politics. The Languedoc-Roussillon in the south of France illustrates oa application of this approach.

37008 (PNL–7337) **Benchmarking of energy time series.** Williamson, M.A. Pacific Northwest Lab., Richland, WA (USA). Apr 1990. 43p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC06-76RL01830. Order Number DE90012674. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Benchmarking consists of the adjustment of time series data from one source in order to achieve agreement with similar data from a second source. The data from the latter source are referred to as the benchmark(s), and often differ in that they are observed at a lower frequency, represent a higher level of temporal aggregation, and/or are considered to be of greater accuracy. This report provides an extensive survey of benchmarking procedures which have appeared in the statistical literature, and reviews specific benchmarking procedures currently used by the Energy Information Administration (EIA). The literature survey includes a technical summary of the major benchmarking methods and their statistical properties. Factors influencing the choice and application of particular techniques are described and the impact of benchmark accuracy is discussed. EIA applications and procedures are reviewed and evaluated for residential natural gas deliveries series

and coal production series. It is found that the current method of adjusting the natural gas series is consistent with the behavior of the series and the methods used in obtaining the initial data. As a result, no change is recommended. For the coal production series, a staged approach based on a first differencing technique is recommended over the current procedure. A comparison of the adjustments produced by the two methods is made for the 1987 Indiana coal production series. 32 refs., 5 figs., 1 tab.

2902 Economics and Sociology

Refer also to citation(s) 36733, 36734, 36745, 36824, 37018, 37027

37009 (CONF-891093–2) **Sources and consequences of hypothetical bias in economic analyses of risk behavior: Draft.** Cantor, R. (Oak Ridge National Lab., TN (USA)); Schoepfle, M.; Szarleta, E. Oak Ridge National Lab., TN (USA). [1989]. 20p. Sponsored by Environmental Protection Agency. DOE Contract AC05-84OR21400. From 36. American Vacuum Society national vacuum symposium; Boston, MA (USA); 23-27 Oct 1989. Order Number DE90012947. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Economic analyses are often used to address the tradeoffs people and constituencies face when selecting among alternative responses to risk changes. These analyses have become increasingly important in recent years as policy makers seek to understand what people will accept or give up to obtain a change in their exposure to risk from, for examples, an hazardous waste site, industrial plant, or biotechnological experiment. The literature on hypothetical bias indicates that the current elicitation techniques to investigate these tradeoffs are not sufficient to ensure meaningful responses to questions about risk preferences and intended behavior. A number of factors can influence the extent of hypothetical bias for a particular risk problem including the type of risk, language, who is affected, property rights, and the decision framework in which the risk problem is posed. We examine the major sources of hypothetical bias for the two predominant elicitation techniques in economics: contingent valuation and experimental economics. For each bias source, we discuss the possible consequences when interpreting the results of the technique, with a special focus on the policy context. We discuss how recent developments in psychology and cognitive anthropology can help mitigate many of the problems associated with hypothetical bias. To conclude, we identify the problems most likely to be resolved satisfactorily for scientific analysis and those that remain in need of further investigation. 38 refs.

37010 (EP-CECO-RA–1988) **Econometrics.** Henry, C. (Centre National de la Recherche Scientifique (CNRS), 75 - Paris (FR)). Ecole Polytechnique, 91 - Palaiseau (France). 1988. 13p. (In French). Order Number DE90500868. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the Econometrics laboratory (Polytechnic School, France), is presented. Microeconomy is the main research field of the Center. The applications involve the market organization, the national development, the natural resources and the education. One of the research topics is the development of theorems which allow a relationship between economic equilibrium and optimization, for the increasing efficiency economies. Concerning industrial economy, the investigations are also based on the in situ studies and on the socio-economic factors. The research projects include land selling transactions and public regulation activities, the environment management and the obtention of educational means. The published papers, the congress communications and the thesis, are listed.

37011 (PB–90-928500/XAB) **Economic and Energy Indicators. Bi-weekly report.** Central Intelligence Agency, Washington, DC (USA). 1990. vp. Available from NTISSubscription.

Supersedes PB–89-928500. Paper copy available on subscription, North American Continent price $110.00/year; all others write for quote. Single copies also available. Issued bi-weekly (26 issues per year).

The Economic and Energy Indicator provides up-to-date information on changes since 1977 in economic and energy activities of major countries. It consists of tables only. They depict economic indicators (industrial production, unemployment, consumer price inflation, and exchange rate trends) for the Big Seven developed countries (United States, Japan, West Germany, France, United Kingdom, Italy, and Canada); foreign trade and foreign trade prices for the Big Seven; and monthly average prices for selected agricultural products and industrial materials. The energy indicators include tables on petroleum consumption, production, and imports for the Big Seven. A table and chart depict the movement of OPEC average crude oil sales prices since 1973.

2903 Environment, Health, and Safety

Refer also to citation(s) 36798, 36805, 36943, 37009, 37019, 37026, 37028, 37385, 37561, 37572, 37574, 37575, 37576, 37577, 37592, 37689, 38321

37012 (DOE/EH–0133) **Tiger Team assessment of the Savannah River Site.** USDOE Assistant Secretary for Environment, Safety and Health, Washington, DC (USA). Jun 1990. 1314p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90011271. Available from NTIS, PC A99/MF A01 - OSTI; GPO Dep.

This draft document contains findings identified during the Tiger Team Compliance Assessment of the US Department of Energy Savannah River Site (SRS), located in three counties (Aiken, Barnwell and Allendale), South Carolina. The Assessment was directed by the Department's Office of the Assistant Secretary for Environment, Safety, and Health (ES&H) and was conducted from January 29 to March 23, 1990. The Savannah River Site Tiger Team Compliance Assessment was broad in scope covering the Environment, Safety and Health, and Management areas and was designed to determine the site's compliance with applicable Federal (including DOE), state, and local regulations and requirements. The scope of the Environmental assessment was sitewide while the Safety and Health assessments included site operating facilities (except reactors), and the sitewide elements of Aviation Safety, Emergency Preparedness, Medical Services, and Packaging and Transportation.

37013 (ORNL–6608/R2) **Environmental regulatory update table, March 1990.** Houlberg, L.M.; Langston, M.E.; Nikbakht, A.; Salk, M.S. Oak Ridge National Lab., TN (USA). Apr 1990. 107p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC05-84OR21400. Order Number DE90012003. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report contains a monthly update of environmental regulatory activity that is of interest to the Department of Energy. It is provided to DOE operations and contractor staff to assist and support environmental management programs by tracking regulatory developments. The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

37014 (ORNL–6608/R3) **Environmental regulatory update table, April 1990.** Houlberg, L.M.; Langston, M.E.; Nikbakht, A.; Salk, M.S. Oak Ridge National Lab., TN (USA). May 1990. 116p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC05-84OR21400. Order Number DE90012004. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report contains a monthly update of environmental regulatory activity that is of interest to the Department of Energy. It is provided to DOE operations and contractor staff to assist and support environmental management programs by tracking regulatory developments. The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a

chronological record of the rulemaking process for that initiative with an abstract and projection of further action.

37015 (ORNL–6608/R4) **Environmental regulatory update table, May 1990.** Houlberg, L.M.; Nikbakht, A.; Salk, M.S. Oak Ridge National Lab., TN (USA). Jun 1990. 116p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012005. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report contains a monthly update of environmental regulatory activity that is of interest to the Department of Energy. It is provided to DOE operations and contractor staff to assist and support environmental management programs by tracking regulatory developments. The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

37016 (ORNL/FTR–3074) **[Control of radiation sources]: Foreign trip report, September 24–October 2, 1988.** Gheesling, S.E. Oak Ridge National Lab., TN (USA). 14 Oct 1988. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012383. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the Technical Committee Meeting on Control of Radiation Sources at the International Atomic Energy Agency (IAEA) Headquarters in Vienna, Austria. The purpose of the committee was to offer the IAEA advice on control and safe usage of sealed radiation sources. Unsealed radiation sources and other radionuclides were not under consideration; however, many of the recommendations in the Committee's report will be equally useful to competent authorities in controlling unsealed radiation sources.

37017 (SAND–89-1380C) **The potential impact of conservation and alternative energy sources on carbon dioxide emissions.** Edenburn, M.W.; Aronson, E.A. Sandia National Labs., Albuquerque, NM (USA). [1990]. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-900823–2: Annual meeting of the Geothermal Resources Council and international symposium on geothermal energy, Kailua Kona, HI (USA), 20-24 Aug 1990). Order Number DE90008346. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In this report, we examine two global energy consumption scenarios to determine how each will contribute to the greenhouse effect and global warming. A steady emissions trend scenario assumes only modest energy conservation and little change in the world's energy conservation and little change in the world's energy consumption patterns. A reduced emissions trend scenario assumes significant conservation and switching from a more carbon-intensive energy source mix to a less intensive mix. Based on the difference between the two scenarios' results, we conclude that it is possible to reduce carbon dioxide emissions by more than 50% by 2050 using a combination of conservation and efficiency improvements and increased use of nuclear, geothermal, and solar/renewable energy sources. 9 refs., 11 figs., 7 tabs.

2904 Energy Resources

Refer also to citation(s) 37021, 37022, 37048, 37049, 37050, 37051, 37052, 37053, 37054, 37055, 37056, 37057, 37058, 37059, 37060, 37061, 37062, 37063, 37064, 37065, 37066, 37067, 37068, 37069, 37070, 37071, 37072, 37073, 37074, 37075, 37076, 37077, 37078, 37079, 37080, 37081, 37082, 37083, 37084, 37085, 37086, 37087, 37088, 37089, 37090, 37091, 37092, 37093, 37094, 37095, 37096, 37097, 37098, 37099, 37100, 37101, 37102, 37103, 37104, 37105, 37106, 37107, 37108, 37109, 37110, 37111, 37112, 37113, 37114, 37115

37018 (TVA/WR/WQ–89/3) **Integrated regional resources management: Based on the experience of the Tennessee Valley Authority.** Oxendine, L.B. (ed.) (Tennessee Valley Authority, Knoxville, TN (USA). Water Quality Dept.); Disinger, J.F. (ed.). Tennessee Valley Authority, Knoxville, TN (USA). Water Quality Dept. Dec 1989. 501p. Sponsored by Tennessee Valley Authority. Order Number DE90012824. Available from NTIS, PC A22/MF A01; OSTI; Tennessee Valley Authority, Evans Building, Room 1W 141A, Knoxville, TN 37902.

The purpose of this text is to communicate to resource managers and decisionmakers in developing countries the potential of Integrated Regional Resources Management in confronting resource development problems, using the Tennessee Valley Authority (TVA) as a primary case study. A wide range of resource-related topics is summarized; the application of resource management concepts, tools, techniques, and practices is discussed as they relate to the achievement of integrated approaches to resource management problems and opportunities. The text also reviews TVA's experiences in applying resource management concepts in practice, in developing useful goals and objectives, and in translating those goals and objectives into specific programs and projects.

37019 **A qualitative architecture for understanding policy responses to global change.** Engi, D. (Sandia National Labs., Albuquerque, NM (USA)). pp. 463 of Proceedings of the 9th Miami international congress on energy and environment. Volume 1-2 (Abstracts). Veziroglu, T.N. Univ. of Miami, College of Engineering, Coral Gables, FL (USA) (1989). (CONF-891210–: 9. Miami international congress on energy and environment, Miami Beach, FL (USA), 11-13 Dec 1989).

One of the most openly discussed and widely debated issues today is that of the potential global environmental impact of man caused by his consumption of the earth's energy resources. Man's consumption of fossil fuels results in releases of billions of tons of gaseous materials into the atmosphere each year and there is clear evidence that the atmosphere is retaining more and more of these materials. It is also generally accepted that the principal constituents of these materials are gases which enhance the greenhouse effect on the earth's atmosphere resulting in higher global temperatures. There is, however, much less agreement on the projected consequences of higher global temperatures. Moreover, there is even less agreement on the specific actions which should be taken in order to properly respond to the potential global changes.

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 37024, 37045, 37046, 37122, 37147, 37148, 37154, 37327, 37334

37020 (AFME–87-91-0002(Vol.3)) **PIRSEM: 1987 operations review. Volume 3.** Agence Francaise pour la Maitrise de l'Energie, 75 - Paris (France). 1988. 319p. (In French). Order Number DE90501027. Available from NTIS (US Sales Only), PC A14/MF A01.

The PIRSEM is a French interdisciplinary research program on energy sciences and base materials with the aim to enhance collaboration between laboratories and application industries for energy conservation. The third volume is concerned with the rational use of electricity in industrial processes and of energy in the transportation sector, with the mineral raw materials (metallurgy, up grading of wastes, ...) and socio-economic aspects of energy.

37021 (DOE/CH/10093–73) **Energy storage and distribution program summary: Volume 2, Research summaries, Fiscal year 1989.** Solar Energy Research Inst., Golden, CO (USA). Jan 1990. 153p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009488. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The Office of Energy Storage and Distribution (OESD) has structured a research program consistent with national energy concerns including increasing oil imports, electricity capacity constraints, growing environmental concerns, and foreign competition. OESD is seeking solutions to these concerns by sponsoring research in two programs: Electric Energy Systems (EES) and Energy Storage (STOR). The combined results of this research will contribute

significantly to the new technologies necessary for ensuring an adequate supply of energy into the 21st century. The EES program supports research on technologies that will allow the electric network of tomorrow to operate more efficiently, be more secure and reliable, accept alternative energy sources, and protect public health and safety. This work includes developing materials such as high-temperature superconductors and conducting polymers for producing electric power devices with higher efficiency and reliability, determining the human health effects of exposure to electric and magnetic fields, analyzing the possible impact of electromagnetic pulses (EMP) on the electric power network, and providing the means to integrate all sources of electrical energy into the existing network. The EES program is composed of four program areas: Electric Field Effects, Reliability Research, Systems Research, and Materials Research. Each of these areas is further subdivided into research activities. 236 refs.

37022 (DOE/ER–0455P) **Basic energy sciences: Summary of accomplishments.** USDOE Office of Energy Research, Washington, DC (USA). Office of Program Analysis. May 1990. 60p. Sponsored by U.S. DOE Energy Research. Order Number DE90011269. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

For more than four decades, the Department of Energy, including its predecessor agencies, has supported a program of basic research in nuclear- and energy-related sciences, known as Basic Energy Sciences. The purpose of the program is to explore fundamental phenomena, create scientific knowledge, and provide unique "user" facilities necessary for conducting basic research. Its technical interests span the range of scientific disciplines: physical and biological sciences, geological sciences, engineering, mathematics, and computer sciences. Its products and facilities are essential to technology development in many of the more applied areas of the Department's energy, science, and national defense missions. The accomplishments of Basic Energy Sciences research are numerous and significant. Not only have they contributed to Departmental missions, but have aided significantly the development of technologies which now serve modern society daily in business, industry, science, and medicine. In a series of stories, this report highlights 22 accomplishments, selected because of their particularly noteworthy contributions to modern society. A full accounting of all the accomplishments would be voluminous. Detailed documentation of the research results can be found in many thousands of articles published in peer-reviewed technical literature.

37023 A guide to increased creativity in research inspiration or perspiration. Loehle, C. *Bioscience (USA)*, 40(2): 123-129 (Feb 1990).

This article discusses the problems involved in maintaining creativity in scientific research under the present system of funding through grant reviews. The author recommends funding of investigators for three- to five-year periods based on the individual's track record rather than to fund a detailed proposal. This practice would free the truly productive scientist from grant-chasing and from making overly rigid research plans.

2906 Nuclear Energy

Refer also to citation(s) 36813, 36933, 37022, 37026, 37034

37024 (CONF-900608–32) **International aspects of Oak Ridge National Laboratory.** Trivelpiece, A.W. Oak Ridge National Lab., TN (USA). [1990]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From American Nuclear Society annual meeting; Nashville, TN (USA); 10-14 Jun 1990. Order Number DE90012798. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The national laboratories of the Department of Energy can rightly claim to be called international laboratories because of their role in international research and development activities. These laboratories have staff that pursue internationally acclaimed research with both national and international colleagues and have facilities that support these endeavors.

37025 (Juel-Spez–551) **'Chernobyl' in the public opinion of the Federal Republic of Germany - risk perception, political attitudes and information.** Hennen, L.; Peters, H.P. Forschungszentrum Juelich GmbH (Germany, F.R.). Programmgruppe Technik und Gesellschaft. Jan 1990. 71p. (In German). Order Number DE90501254. Available from NTIS (US Sales Only), PC A04/MF A01.

The information behaviour of the population after Chernobyl was characterized by a sceptical attitude to reporting in the media, which was frequently considered to be inaccurate. A critical attitude was, however, also revealed towards primary information sources such as the government, opposition, nuclear research centres, industry, action groups and ecological research institutes. The majority of the population are evidently oriented both towards statements from established institutions such as the government and nuclear research centres as well as to information from institutions and persons critical of nuclear energy; they therefore did not shut their eyes to contradictions in the published information. It became clear that a majority of the respondents had a preference for a decentralized information policy where the public has unimpeded access to as many information sources as possible. (orig.).

2910 Conservation

Refer also to citation(s) 37017, 37030, 37048, 37049, 37050, 37051, 37052, 37053, 37054, 37055, 37056, 37057, 37058, 37059, 37060, 37061, 37062, 37063, 37064, 37065, 37066, 37067, 37068, 37069, 37070, 37071, 37072, 37073, 37074, 37075, 37076, 37077, 37078, 37079, 37080, 37081, 37082, 37083, 37084, 37085, 37086, 37087, 37088, 37089, 37090, 37091, 37092, 37093, 37094, 37095, 37096, 37097, 37098, 37099, 37100, 37101, 37102, 37103, 37104, 37105, 37106, 37107, 37108, 37109, 37110, 37111, 37112, 37113, 37114, 37115, 37131

2920 Supply, Demand, and Forecasting

37026 (CONF-900608–30) **Balancing the roles for conservation, coal, nuclear, and other energy systems.** Trivelpiece, A.W. Oak Ridge National Lab., TN (USA). [1990]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From American Nuclear Society annual meeting; Nashville, TN (USA); 10-14 Jun 1990. Order Number DE90012768. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The energy technology future of the United States is clouded by two major uncertainties: our future energy demand and the seriousness and urgency of the greenhouse effect and of other environmental, health, and safety problems. These uncertainties require a broad-based approach in meeting present energy needs. Any effort to match long-term energy needs mandates a multidisciplinary research and development effort to focus on end-use technologies.

37027 (CONF-9008104–1) **Forces shaping the energy required to support western hemisphere development.** Jones, D.W. Oak Ridge National Lab., TN (USA). 3 May 1990. 6p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC05-84OR21400. From Pan American engineers: partners for progress; Washington, DC (USA); 19-24 Aug 1990. Order Number DE90011641. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Projections of energy consumption incurious from 1985 to 2000 for Argentina, Brazil, Colombia, Mexico, and Venezuela are made on the basis of projected changes in per capita income, urbanization, and industrialization. In the most likely scenarios, by 2000, most of these countries could consume 40 to 90 percent more energy than they did in 1985. In a range of low and high growth and development scenarios, the range projections extends from 23 to 128 percent. This paper identifies several major changes that a country will experience as its economy develops and discuss how these changes will influence energy consumption. These influences include per capita income growth, urbanization, and industrialization. After discussing how each of these events energy consumption, I assess the potential for further change in that component of development is several, major Latin America nations: Argentina, Brazil, Colombia, Mexico, and Venezuela. On the basis

of these events, I offer some numerical projections of possible changes in energy use in each country. 8 refs., 1 tab.

37028 **Energy, development and environment: planetary stakes in the 21st century.** Dessus, B. (Centre National de la Recherche Scientifique, 75 - Paris (France)). *Revue de l'Energie (France)*, 40(415): 978-992 (Nov 1989). (In French).

Are energy consumption management and recourse to renewable energies significant ways to respond to the stakes of the 21st Century. Energy management, far from constituting a brake to progress, is a dynamic and structuring element for progress in the medium and long term, examples chosen from highly varied fields of economic and social activity are given. The penetration of renewable energies into the energy balances of the 21 st Century, is examined. It is necessary to complete the conventional analysis of renewable energy resources by a rational, priced approach to renewable energy reserves the preparation of renewable energy reserve maps, region by region is made. Ecological consequences of the various energy strategies proposed in the medium and long term, especially the greenhouse effect problem are discussed.

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 36734, 36772, 37018, 37131, 38321

37029 (DOE/CS–0188) **Compendium of Federal legislation, policies and procedures: Guidance for the administration of DOE grants and cooperative agreements.** USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Office of State and Local Assistance Programs. Oct 1980. 633p. Sponsored by U.S. DOE Conservation & Renewable Energy. Order Number DE90012659. Available from NTIS, PC A99/MF A01 - OSTI.

This Compendium of Federal Legislation, Policies and Procedures, contains the basic materials which govern the administration of DOE grant programs and cooperative agreements. Included are the relevant Public Laws, sections of the Code of Federal Regulations, OMB Circulars, Federal Management Circulars, Treasury Circulars, and Federal Procurement Regulations. To our knowledge this represents the first effort to collect these materials under a single cover. Our purpose in doing so is to provide program officials with a convenient and comprehensive reference document to assist in the day-to-day management of DOE grant and cooperative agreement programs. The Compendium is intended as a companion document to the Coordinated State/Local Energy Conservation Grant Programs Manual (CPM) which will be issued later this year. The CPM is designed as a systematic guide to procedures for the administration of energy conservation grant programs. As such, it both interprets and expands on the material in the Compendium. We hope you will find these documents useful and that they will contribute in some measure to the overall effectiveness of the grants management process.

37030 (DOE/OR/21400–T458) **The federal government should do more to improve US energy efficiency.** Hirst, E.; Carlsmith, R. Oak Ridge National Lab., TN (USA). 6 Jun 1990. 11p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90012863. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper includes statements by Mr. Eric Hurst and Mr. Roger Carlsmith, both of ORNL, to the US Congressional Subcommittee on Energy Research and Development. Hr. Hurst and Mr. Carlsmith discussed opportunities available to the United States to conserve energy between now and the year 2010. Barriers to energy conservation are initially presented. Technology to overcome these barriers are discussed. 12 refs., 1 fig., 1 tab. (FSD)

37031 (ORNL/NSP–90/3) **KWOC [Key-Word-Out-of-Context] Index of US Nuclear Regulatory Commission Regulatory Guide Series.** Jennings, S.D. Oak Ridge National Lab., TN (USA). Apr 1990. 56p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90011292. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

To meet the objectives of the program funded by the Department of Energy (DOE)-Nuclear Energy (NE) Technology Support Programs, the Performance Assurance Project Office (PAPO) administers a Performance Assurance Information Program that collects, compiles, and distributes program-related information, reports, and publications for the benefit of the DOE-NE program participants. THE "KWOC Index of US Nuclear Regulatory Commission Regulatory Guide Series" is prepared as an aid in searching for specific topics in the US Nuclear Regulatory Commission, Regulatory Guide Series.

2940 Fossil Fuels

Refer also to citation(s) 36730, 36731, 36732, 36733, 36734, 36745, 37011, 37139

37032 (DOE/FE–0182P) **Alternative fuels program: Fiscal year 1990, Summary program plan.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of the Deputy Assistant Secretary for Coal Technology. Sep 1989. 30p. Sponsored by U.S. DOE Fossil Energy. Order Number DE90012710. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

One of the specific missions of the Office of Fossil Energy (FE) at DOE is to conduct R&D programs aimed at increasing the contribution of coal as a national energy resource by making improvements in environmental, technical, and economic performance, and by increasing the number of areas of application and the end-use flexibility of coal-based systems. This will allow industry to bring economically competitive and environmentally acceptable coal technology options into the marketplace. A five-year plan sets forth the R&D activities of the US DOE's Fossil Energy Alternative Fuels Program for 1990 through 1994. The R&D activities are necessary to provide versatile coal-based fuel substitutes for oil and natural gas, while simultaneously significantly reducing environmental pollutants, such as acid rain precursors, associated with the utilization of fossil fuels. In developing and implementing this plan within the Office of Coal Technology (OCT), the Office of Coal Combustion, Coal Preparation and Control Systems, and its technology centers are working directly with university, industrial, and other federal and state organizations as well as with similar organizations on an international scale through Memorandums of Understanding (MOUs) with the governments of the countries involved. 2 figs., 2 tabs.

2960 Electric Power

Refer also to citation(s) 37001, 37124

37033 (CONF-900833–1) **Integrated resource planning for electric and gas utilities.** Hirst, E. (Oak Ridge National Lab., TN (USA)); Goldman, C.; Hopkins, M.E. Oak Ridge National Lab., TN (USA). [1990]. 27p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From ACEEE summer study on energy efficiency in buildings; Pacific Grove, CA (USA); 26 Aug - 1 sep 1990. Order Number DE90012728. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During the past few years, the scope and nature of resource planning at electric utilities has changed dramatically. The scope of planning has expanded to consider energy-efficiency and load-management programs as resources, the environmental costs of electricity production, and a variety of resource-selection criteria beyond electricity price. The nature of planning has expanded to include regulatory commissions, nonutility energy experts, and customers, as well as utilities themselves. Similar changes are beginning to occur at gas utilities. This paper discusses a few of the key issues related to resource planning: provision of financial incentives to utilities for successful implementation of integrated resource plans, incorporation of environmental factors in resource planning, bidding for demand and supply resources, development of guidelines for preparation and review of utility integrated resource plans, resource planning for gas utilities, and greater efforts by the US Department of Energy to encourage integrated resource planning. 55 refs., 2 figs., 4 tabs.

37034 (DOE/EIA–0226(90/03)) **Electric Power Monthly, March 1990.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate

Fuels. 14 Jun 1990. 180p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE90012924. Available from NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.

The Electric Power Monthly (EPM) presents monthly summaries of electric utility statistics at the national, Census division, and State level. The purpose of this publication is to provide energy decision-makers with accurate and timely information that may be used in forming various perspectives on electric issues that lie ahead.

37035 (DOE/EIA–0474(90)) **Annual outlook for US electric power 1990: Projections through 2010.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 14 Jun 1990. 71p. Sponsored by U.S. DOE Management & Administration. Order Number DE90012750. Available from NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.

Section 205(a)(2) of the Department of Energy Organization Act of 1977 (Public Law 95-91) requires the Administrator of the Energy Information Administration (EIA) to carry out a comprehensive program that will collect, evaluate, assemble, analyze, and disseminate data and information relevant to energy resources, reserves, production, demand, technology, and related economic and statistical information. To assist in meeting these responsibilities in the area of electric power, EIA has prepared this report, Annual Outlook for US Electric Power 1990. In order to provide timely regional forecasts, this year's Outlook is shorter than prior editions. The report contains two chapters. Chapter 1 presents 1989 data highlights major events affecting the electric power industry in 1989. Chapter 2 provides national level projections of sources and uses of electricity through the year 2010. The appendices to this report provide detailed assumptions (Appendix A), and regional projections of this year's forecasts (Appendices B, C, and D). The report is intended for a general audience. It should be of particular interest to public utility analysts, policy and financial analysts, investment firms, trade associations, Federal and State regulators, and legislators. 5 figs 7 tabs.

37036 (DOE/EIA–0531(86)) **Electric trade in the United States, 1986.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 11 Jun 1990. 299p. Sponsored by U.S. DOE Management & Administration. Order Number DE90012819. Available from NTIS, PC A13/MF A01 - GPO - OSTI; GPO Dep.

The Electric Trade in the United states 1986 (ELTRA) was prepared by the Data Systems Branch, Electric Power Division, Office of Coal, Nuclear, Electric and Alternate Fuels, Energy Information Administration (EIA). This report provides data on electric trade at the national, regional, and electric utility level. In an atmosphere of changes going on in the industry that may alter access to the Nation's transmission system, it has become apparent that additional data of this type need to be publicly available. The Office of Technology Assessment of the US Congress report Electric Power Wheeling and Dealing and the Federal Energy Regulatory Commission (FERC) report The Transmission task Force's report to the Commission, October 1989 both call for information on bulk power markets (wholesale trade) and the quantities of electricity carried by the US transmission system. The Electric Trade in the United States 1986 provides information on these subjects and on the US electric utility industry's domestic and international wholesale trade. 4 figs., 36 tabs.

37037 (ORNL/CON–299) **The market penetration of energy-efficiency programs.** Berry, L. Oak Ridge National Lab., TN (USA). Apr 1990. 79p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC05-84OR21400. Order Number DE90011295. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The focus of this report is on one source of resource planning uncertainty: the expected market penetration of DSM (Demand Site Management) programs. Its purpose is to help refine planning assumptions and reduce uncertainty about the market penetration of utility DSM programs by: (1) investigating concepts and definitions of market penetration, (2) reviewing data that characterize patterns of variation (including ranges, averages and maximum levels) in program participation rates, (3) identifying the factors that affect participation, and (4) reviewing the structure and data requirements of models that forecast market penetration. 84 refs., 14 figs., 16 tabs.

37038 (ORNL/CON–300) **Key issues in electric utility integrated resource planning: Findings from a nationwide study.** Schweitzer, M.; Yourstone, E.; Hirst, E. Oak Ridge National Lab., TN (USA). Apr 1990. 83p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90011296. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Resource planning of various types has been performed by electric utilities for many years. Recently, however, many utilities, often with the encouragement of their state Public Utility Commission, have begun preparing least-cost plans. These documents differ from earlier resource plans in a number of ways, but perhaps most notable is their increased attention to demand-side (conservation and load management) programs. This report presents findings from a study performed by Oak Ridge National Laboratory (ORNL) in which the least-cost plans and planning processes of 29 utilities and five non-utility government agencies (four state and one federal) throughout the United States were examined. The purpose of this study was to gather representative data on the current practice of least-cost planning and to make this information available to utilities, regulators, and other parties interested in this rapidly growing field. 69 refs., 9 figs., 14 tabs.

2980 Consumption and Utilization

Refer also to citation(s) 37126

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 36824, 37005, 37028

30 DIRECT ENERGY CONVERSION

3001 MHD Generators

37039 (CONF-9006105–8) **Compendium of MHD-related terminology.** Hart, A.T. (MSE, Inc., Butte, MT (USA)); Lofftus, D.A.; Rudberg, D.A.; Green, R.A. MSE, Inc., Butte, MT (USA); Mississippi State Univ., Mississippi State, MS (USA). [1990]. 5p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC02-80ET15601 ;AC07-88ID12735. From 28. symposium on engineering aspects of magnetohydrodynamics; Chicago, IL (USA); 26-28 Jun 1990. Order Number DE90012867. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The magnetohydrodynamic (MHD) researchers in the United States have joined together in the past few years to prove the viability of the technology. As new designs for hardware methods of operation, approaches for data analysis, and levels of understanding have been atained, a set of MHD-unique terminology has been developed but not always documented. A glossary of terminology unique to the study of MHD was compiled for SEAM 27 to provide an information source for workers in this field and to assist those interested in the commercial potential of MHD in reading and understanding technical articles on the subject. The terminology defined was primarily related to the US proof-of-concept program of MHD development and eventual retrofitting of a coal fired plant with MHD equipment. Basic theoretical terms as well as terminology related to the commercialization of MHD were presented. Emphasis was placed on terms related to commercialization and those related to currently active areas of study. This paper builds on the SEAM 27 contribution. Areas of concentration in this paper are retrofit/power plant terminology, advanced measurement technology applicable to MHD, research sites. 3 refs., 1 figs.

37040 (DOE/ET/10815–149) **Characterization of flow disturbances in a coal fired combustion flow train.** Winkleman, B.C.; Giel, T.V.; Lineberry, J.T.; Yang, D.J. Tennessee Univ., Tullahoma, TN (USA). Space Inst. [1990]. 14p. Sponsored by U.S. DOE Fossil

Energy. DOE Contract ACu2-79ET10815. (CONF-9006105–6: 28. symposium on engineering aspects of magnetohydrodynamics, Chicago, IL (USA), 26-28 Jun 1990). Order Number DE90012632. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Audible rumbles are known to accompany operation of the CFFF low mass flow train and visual/aural observations indicate simultaneous dropouts in the diffuser light emission. Three hypotheses, coal flow disturbances, combustion instabilities, and slag entrainment into the flow, are presented as possible causes of the rumbles. Wideband instrumentation including line reversals, luminosities, and dynamic pressures were used to investigate the rumble phenomena. The observational evidence implies that briefly before the rumble sound, the vitation heater pressure rises and a cold opaque structure moves from upstream to downstream through the aerodynamic duct, diffuser, and radiant furnace. Steady state thermodynamic analysis of the flow train at conditions corresponding to measured rumble phenomena are presented. It is concluded that a dispersed structure of slag particles entrained from the combustor is the most viable hypothesis. 8 refs., 23 figs., 2 tabs.

37041 (DOE/ET/10815–150) **EPA [Environmental Protection Agency] performance tests for particulate and SO_2 conducted at the DOE Coal-Fired Flow Facility.** Rasnake, D.G.; Douglas, J.R.; Lynch, T.P.; Holt, J.K. Tennessee Univ., Tullahoma, TN (USA). Space Inst. [1990]. 8p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC02-79ET10815. (CONF-9006105–7: 28. symposium on engineering aspects of magnetohydrodynamics, Chicago, IL (USA), 26-28 Jun 1990). Order Number DE90012633. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Results of Environmental Protection Agency (EPA) performance tests conducted at the DOE's Coal Fired Flow Facility (CFFF) are reported. During 1989 a series of compliance tests for emissions of particulates and SO_2 were conducted under the supervision of the Tennessee Department of Health and Environment's Air Pollution Control Board using standard EPA methods. The CFFF met all compliance requirements for state permitting with mass emissions of approximately 0.05 pounds per million Btu (lb/MMBtu) and sulfur dioxide emissions averaging 0.5 lb/MMBtu. Current limits under state law allow for particulates and SO_2 emissions of 0.19 and 5.0 lb/MMBtu, respectively. Tougher federal new Source Performance Standards (NSPS) for SO_2 emissions were also met by the facility during compliance testing. 6 figs., 3 tabs.

3003 Thermoelectric Generators

37042 (AERE-M–3795) **On the use of oxides for thermoelectric refrigeration.** Macklin, W.J.; Moseley, P.T. UKAEA Harwell Lab. (UK). Materials Development Div. Feb 1990. 18p. Order Number DE90799625. Available from NTIS (US Sales Only), PC A03/MF A01.

Some of the complex oxides of copper that have been intensively studied in pursuit of high temperature superconductivity exhibit Seebeck coefficients that are stoichiometry-dependent and can attain high values relative to other oxides. In this note the possibility that the properties of the complex copper oxides might be adjusted so as to make them viable candidates for use in thermoelectric refrigeration, is investigated. The successful implementation of thermo electric refrigeration on a large scale would, of course, bring considerable environmental benefits. (author).

37043 (ORNL/M–1137) **Operational readiness review plan for the radioisotope thermoelectric generator materials production tasks.** Cooper, R.H.; Martin, M.M.; Riggs, C.R.; Beatty, R.L.; Ohriner, E.K.; Escher, R.N. Oak Ridge National Lab., TN (USA). 19 Apr 1990. 26p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE90012026. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In October 1989, a US shuttle lifted off from Cape Kennedy carrying the spacecraft Galileo on its mission to Jupiter. In November 1990, a second spacecraft, Ulysses, will be launched from Cape Kennedy with a mission to study the polar regions of the sun. The prime source of power for both spacecraft is a series of radioisotope thermoelectric generators (RTGs), which use plutonium oxide (plutonia) as a heat source. Several of the key components in this power system are required to ensure the safety of both the public and the environment and were manufactured at Oak Ridge National Laboratory (ORNL) in the 1980 to 1983 period. For these two missions, Martin Marietta Energy Systems, Inc. (Energy Systems), will provide an iridium-alloy component used to contain the plutonia heat source and a carbon-composite material that serves as a thermal insulator. ORNL alone will continue to fabricate the carbon-composite material. Because of the importance to DOE that Energy Systems deliver these high-quality components on time, performance of an Operational Readiness Review (ORR) of these manufacturing activities is necessary. Energy Systems Policy GP-24 entitled "Operational Readiness Process" describes the formal and comprehensive process by which appropriate Energy Systems activities are to be reviewed to ensure their readiness. This Energy System policy is aimed at reducing the risks associated with mission success and requires a management-approved " readiness plan" to be issued. This document is the readiness plan for the RTG materials production tasks. 6 refs., 11 figs., 1 tab.

3005 Fuel Cells

37044 (DOE/MC/23266–2841) **Electrode reaction mechanisms in molten carbonate fuel cells: Final report.** Selman, J.R.; Nishina, T.; Lin, Y.P.; Yeager, E.B.; Tryk, D.A. Illinois Inst. of Tech., Chicago, IL (USA). Dept. of Chemical Engineering; Case Western Reserve Univ., Cleveland, OH (USA). Case Center for Electrochemical Sciences. Jul 1989. 154p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-86MC23266. Order Number DE90009651. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This report describes the results of a joint research effort at Illinois Institute of Technology (IIT) and Case Western Reserve University (CWRU) to elucidate the reaction mechanism of oxygen reduction at the cathode of the molten carbonate fuel cell (MCFC). This research project was aimed at developing novel experimental approaches to the chemistry and electrode kinetics of oxygen reduction under MCFC conditions, and improving our fundamental understanding of the reaction mechanism as it applies to the MCFC. IIT's contribution was focused on developing and using rotating electrodes with well-defined mass-transfer properties, to characterize the electrode kinetics of oxygen reduction in molten carbonate. CWRU's contribution was focused on developing and using micro-electrodes for the same purpose, and also on developing spectroscopic cells and carrying out various types of spectroscopic measurements to characterize the oxygen species in molten carbonate under MCFC conditions. This report is divided into two main parts. Part 1 provides the technical background of the questions concerning oxygen reduction in molten carbonate as they apply to the MCFC system. The methodological approach and the objectives of the research are also presented. The second part describes the development of the rotating electrodes, micro-electrodes and spectroscopic cells and the results of measurements, as well as the interpretation of the data. Conclusions of this project, including some recommendations for further research, are also given in this part. 111 refs., 69 figs., 7 tabs.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

Refer also to citation(s) 37020

37045 (AFME–87-91-0002(Vol.1)) **PIRSEM: 1987 operations review. Volume 1.** Agence Francaise pour la Maitrise de l'Energie, 75 - Paris (France). 1988. 343p. (In French). Order Number DE90501029. Available from NTIS (US Sales Only), PC A15/MF A01.

The PIRSEM is a French interdisciplinary research program on energy sciences and base materials with the aim to enhance collaboration between laboratories and application industries for energy conservation. The first volume is concerned with fossil fuels (coal and oil) and several renewable energies: geothermal energy, photovoltaic, photochemical and heliothermal conversion.

37046 (AFME–87-91-0002(Vol.2)) **PIRSEM: 1987 operations review. Volume 2.** Agence Francaise pour la Maitrise de l'Energie,

75 - Paris (France). 1988. 462p. (In French). Order Number DE90501028. Available from NTIS (US Sales Only), PC A20/MF A01.

The PIRSEM is a French interdisciplinary research program on energy sciences and base materials with the aim to enhance collaboration between laboratories and application industries for energy conservation. The second volume is concerned with renewable energies (conversion of solar energy through a biological way), rational use of energy (in dwellings and in industries).

37047 (ETSU-R-52) **Energy efficiency demonstration scheme: June 1988 review of ETSU portfolio.** UKAEA Harwell Lab. (UK). Energy Technology Div.; Department of Energy, London (UK). Apr 1989. 198p. Order Number DE90799627. Available from NTIS (US Sales Only), PC A09/MF A01.

This review covers the Energy Efficiency Demonstration Scheme activities that were managed by ETSU on behalf of the Energy Efficiency Office of the Department of Energy. This report reviews the situation at June 1988 which corresponded to the third major target set for the Programme (the so called T_3 target of 3Mtce energy savings which was exceeded). Progress towards the targets set for energy saving, cost effectiveness and expenditure is discussed and shown to be very satisfactory. Detailed Appendices on the individual sectors/sub-sectors, into which the industrial portfolio has been sub-divided, are presented. These enable the reader to see for each sector/sub-sector, the range of projects undertaken, the extent of progress and the areas of possible future innovation in energy efficiency. Where appropriate, the extent of other EEO programmes such as the M and T Programme or the R and D programme are noted and any integrated efforts commented upon. (author).

3201 Buildings

Refer also to citation(s) 36850, 36851, 36852, 36853, 36854, 36855, 36877, 37001

37048 (CONF-890845–, pp. 3-9) **An evaluation of the Bonneville Power Administration wood heat displacement program.** Lerman, D.I. (ERC Environmental and Energy Services Co., Portland, OR (USA)); Haeri, M.H. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

The Pacific Northwest has had surplus electric energy since the early 1980s. Energy produced by the regional power system, for which the Bonneville Power Administration is the primary purchaser and distributor, is more than sufficient to cover the current needs of Bonneville's customer utilities. Some of the surplus is exported from the Pacific Northwest in the form of sales to utilities in other states, principally California. A portion of the surplus is also marketed to Bonneville's customers in the Northwest under various surplus sales programs. Under these programs, short-term load growth is promoted through discounted rates for incremental usage. Between November 1987 and June 1988 the authors conducted an evaluation of one such marketing program, the Bonneville Wood Heat Displacement Program. The study had both process and outcomes components. The process evaluation examined variations in implementation across utilities, program penetration among utility consumers, and perceptions of program strengths and weaknesses. The outcomes component of the evaluation covered program impacts: the effect on Bonneville's revenues and loads, and the amount of increased usage. To assess the impact on residential energy consumption among wood heat consumers, we examined billing histories for participants and a sample of non-participants at seven participating utilities. We examined changes in kwh consumption for program participants and non-participants over time in three different approaches: (1) a comparison of raw consumption during pre-program and program heating seasons: (2) a comparison of weather-adjusted total annual consumption for the same two periods: and (3) a comparison of weather-adjusted heating loads for the pre-program and program years. We used the Princeton Scorekeeping Method (PRISM) for weather-normalization in the latter two approaches. 2 figs., 2 tabs.

37049 (CONF-890845–, pp. 11) **Comparative analysis of the effect of incentives on weatherization programs.** Ecker, L.K. (Central Maine Power Co., Augusta, ME (USA)); Michelsen, L. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

The paper and presentation focuses on the results of a comparative analysis for four pilot residential weatherization and insulation programs conducted by Central Maine Power Company during 1985 and 1986. The programs were designed to meet three goals: (1) to study the effect of incentives as motivation for installing energy management measures, (2) to explore how to deliver services to our electric space heating customers, and (3) to measure electricity savings. Included are sample and control group selection, program design, program marketing, the resulting participation, estimates of energy savings, and cost-effectiveness.

37050 (CONF-890845–, pp. 13-17) **The Michigan low-income weatherization energy education and incentives program.** Witte, P. (Michigan Public Service Commission, Lansing (USA)); Kushler, M.G. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

This paper describes and presents preliminary findings for a pilot program designed to investigate the effect of energy education and financial incentives on the fuel consumption of high gas consumers whose energy bills are paid through public assistance. To evaluate the program, 231 recent Home Repair and Weatherization (HR/W) recipients were randomly assigned to either receive or not receive the education and incentive program. There were four key elements to the program design: (1) free distribution of several low cost energy efficiency measures and on-site instruction on their installation; (2) on-site information on several simple behavioral practices that would save energy; (3) up to three separate financial incentives (ranging from $15-20) for achieving agreed upon energy conservation goals; and (4) regular structured feedback to the participants on their progress in attaining these goals. Results indicated that 83% of the participants qualified for the first incentive by installing the targeted conservation measure (i.e., plastic storm windows). An average of storm windows per home were installed. Fuel bill analyses have been completed for two post-service months and reveal that the education/incentive group saved significantly more energy than the repair and weatherization only control group in each month (approximately 24% and 26% versus 16% and 19%). These and other results are discussed. 1 ref., 2 tabs.

37051 (CONF-890845–, pp. 21-26) **Marketing energy of conservation in an environment of abundance.** Fowler, H. (Sacramento Municipal Utility District, CA (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Current projections for energy supply and demand in California call for an abundance of both for the near future. With Diablo Canyon and San Onofre nuclear generating stations both producing, forecasts are nearly unanimous in predicting a surplus of energy through the year 2000 in California and the Northwest. Optimism and official state forecasts for energy sufficiency for the next 10-15 years have led most energy customers to believe that there is little need for energy conservation - at least, not until there is a much more dramatic increase in the price of electricity. Many approaches have tried to overcome customer reluctance to conserve in an environment of apparent energy abundance. This paper explores several such approaches and techniques used in the Sacramento area. The relative advantages and disadvantages of these techniques are discussed and some tentative conclusions drawn regarding possible application to other situations. One of the most useful indicators of a program's value and effectiveness has

been the ratio of its benefits compared to its costs. A number of assumptions go into quantifying benefits and costs of load management and energy conservation programs. This paper presents the primary assumptions and some preliminary data developed to evaluate the benefit/cost ratios of one utility energy conservation product sales program. One of the early conclusions reached was that not all of the assumptions used to quantify costs and benefits were both accurate and measurable. Consequently, some of the quantification schemes were modified to be more useful and realistic, thereby improving the objectivity of the results. These revised assumptions for the benefit cost calculations are explored. However, not all of the factors which could be included on both sides of the benefit cost equation are quantified in this study; these factors are listed for possible inclusion in the future. 2 tabs.

37052 (CONF-890845–, pp. 27-32) **Demand-side management and economic development: A practical discussion.** White, D.S. (New England Power Service Co., Westborough, MA (USA)); Crandall, G.C. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

One argument often put forward in support of demand side management programs is that, in general, these types of efforts tend to capture other indirect benefits, or externalities. Demand-side activities are thought to have greater economic and environmental benefits relative to traditional supply-side utility resources. At present, several states are exploring ways in which to incorporate externalities into utilities resource planning and evaluation processes. The obvious problem is how to estimate these externalities in a manner that is both analytically sound and cost-effective. The focus of this paper is on one such effort that was undertaken for the State of Michigan. The purpose of the Michigan analysis was to estimate the amount of state wide economic impact achieved through the operation of the Michigan Residential Conservation Services (MRCS) Program. Using the evaluation as a case study, the paper will attempt to show the large indirect economic benefits associated with this particular program. It will also demonstrate, however, some of the difficulties and limitations associated with these types of analyses. Finally, policy implications involved in pursuing programs to capture these indirect benefits will be discussed. 1 fig., 2 tabs.

37053 (CONF-890845–, pp. 33-38) **Promoting the commercialization of energy innovations: An evaluation of the energy-related inventions program.** Brown, M.A. (Oak Ridge National Lab., TN (USA)). Argonne National Lab., IL (USA). [1989]. DOE Contract AC05-84OR21400. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

This paper presents the results of an evaluation of the U.S. Department of Energy's Energy-Related Inventions Program (ERIP). ERIP provides small grants and technical assistance to small businesses and independent inventors attempting to develop and commercialize new energy technologies. The primary purpose of this evaluation is to assess the effectiveness of ERIP in moving these technologies from the laboratory bench to the marketplace. A secondary purpose is to better understand the commercialization process so that the program can better target its services. The research design involves analysis of data on 250 ERIP participants and a comparison of findings with previous research. Appropriately one-fourth of the inventions funded by ERIP have entered the market, and a majority of these have experienced sustained sales. For those ERIP-supported technologies that have experienced sales, it takes an average of seven years and $1.1 million to progress from concept to commercial product, and an additional two years and $0.8 million to achieve full production status. Comparative statistics from the literature indicate that ERIP technologies are generally more successful than similar technologies that have not participated in the program. This success is attributed to the assistance provided by the program. The paper ends with a discussion of alternative evaluation methods. 10 refs., 2 figs., 2 tabs.

37054 (CONF-890845–, pp. 41-45) **Third party contracting versus customer programs for commercial/industrial customers.** Hicks, E.G. (New England Public Power Co., Westborough, MA (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

New England Electric System (NEES) currently offers two types of incentive programs to encourage its largest commercial and industrial customers to invest in conservation and load management. The first program is a demand-side bidding experiment where NEES purchases conservation and load management from energy services companies (ESCOs) on a price per kw basis. This program is called the Performance Contracting Program. The second program is a Custom Rebate program, where NEES will pay an incentive of up to $500/kw for any conservation or load management investment the customer wishes to make. This paper will first briefly describe NEES and the Company's earlier experiences in demand-side bidding. The paper will then present a comparison of the two programs to date. The comparison will include: customer satisfaction, participation levels, demand savings, and cost-effectiveness. 5 refs., 4 figs., 2 tabs.

37055 (CONF-890845–, pp. 47-52) **Comparative analysis of three commercial sector financing mechanisms.** Peters, J.S. (ERC Environmental and Energy Services Co., Portland, OR (USA)); Haeri, M.H. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

During 1988 the Bonneville Power Administration engaged the authors to conduct a comparative analysis of incentive structures in three commercial sector programs offered in the Pacific Northwest. Two of the programs are offered by Bonneville (the Purchase of Energy Savings Pilot Program and the Commercial Incentives Pilot Program) and one program is offered by Puget Sound Power & Light (the Puget Incentive Program). Our analysis was primarily qualitative, relying on interviews with key informants. However, actual bids, installation costs and estimated savings were used in portions of the analysis. We examined four major topics: (1) the impact of incentive structures on participation: (2) assessment of a three bid requirement as a means of cost control; (3) assessment of Bonneville's all cost-effective measures requirement: and (4) the cost to Bonneville and the Pacific Northwest of acquiring commercial sector demand side resources. We found the three incentive structures all to be readily marketable to the commercial sector. However, the two Bonneville programs have complex program and incentive structures and are more difficult to explain to customers. The general consensus from program staff was that ease of participation is a more important concern to owners than incentive amounts, and that incentive structures should similarly be simple to explain and implement. Our assessment of the three bid requirement indicated that such an approach did not provide certainty that least cost jobs will result. The effectiveness of bidding hinges on the quality of project design and specifications used for the bids. A best bid approach provides the opportunity to assure quality work is installed, while a low bid approach assures that the work is low cost. However, without adequate specifications bids cannot be effectively compared in either approach. 1 fig., 4 tabs.

37056 (CONF-890845–, pp. 53-59) **Evaluation of DOE's [Department of Energy] resource-leveraging partnerships for low-income weatherization.** Lee, A. (Pacific Northwest Lab., WA (USA)); Callaway, J. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

In July 1986, the U.S. Department of Energy (DOE) awarded competitive grants to five states to conduct pilot projects establishing partnerships and using resource leveraging to stimulate support for low-income residential energy retrofits. The projects were conducted under DOE's Partnerships in Low-Income Residential Retrofit (PILIRR) Program. These projects have been monitored and analyzed through a concurrent process evaluation conducted by the Pacific Northwest Laboratory (PNL). The goal of the PILIRR Program was to demonstrate that states could use resource-leveraging partnerships to stimulate non-federal resources in support of low-income residential energy improvements. The evaluation relied on qualitative analysis to determine whether the states met DOE's goal. Several of the states were successful in meeting DOE's goal. This paper describes the state programs and provides observations about what factors affected program success. 4 refs., 3 tabs.

37057 (CONF-890845–, pp. 63-65) **Impact evaluation of project HELP: Direct weatherization for low-income, elderly, and handicapped customers.** Train, K. (Univ. of California, Berkeley (USA)); Schuck, L. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Project HELP, developed and funded by Pacific Gas and Electric (PGE), is currently the largest utility-sponsored direct weatherization program in the nation for low-income, elderly, and handicapped customers. By the end of March 1989, more than 270,000 residences had been served by this program, at no cost to the participants. The Project provides free installation of ceiling insulation, weatherstripping, caulking, energy-saving shower heads, duct wrap, and water heater blankets. In addition, the program provides up to $200 worth of minor home repair to ensure that conservation measures installed in each residence perform efficiently. Post-installation inspections are conducted on 100% of residences receiving attic insulation and 20% of the units that had other measures installed but not attic insulation. PG&E contracts with an experienced energy conservation management firm to assist in the administration and management of the program. This management firm subcontracts the installation of weatherization measures to both private and community-based organizations, selected on the basis of competitive bid. The subcontractors locate and qualify potential participants and perform the weatherization. The objective of the impact evaluation was to determine the energy savings that resulted from the program. In particular, the evaluation goals were to: (i) determine the extent to which units that were weatherized under the program experienced a reduction in gas and electricity use as a result of the program, (ii) determine the impact of the weatherization on customers' energy bills, and (iii) analyze the variation in energy savings by measure, end-use, region, whether the weatherization was performed by a community-based organizations versus a private firm, and building type. The methodology and findings of this evaluation are the subject of this paper. 1 fig., 1 tab.

37058 (CONF-890845–, pp. 67-71) **Durability of fuel savings for single-family households: Ohio Home Weatherization Assistance Program (HWAP) program years 1985 and 1986.** Gregory, J.M. (Cleveland State Univ., OH (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Ohio's Home Weatherization Assistance Program (HWAP), one of several conservation programs in Ohio created to assist low-income families, began in 1977 in response to rising energy costs. The program is administered by Ohio's Department of Development Office of Weatherization (ODOD/OWx). By the end of 1987, nearly 118,000 households had been served by HWAP. In 1986, ODOD/OWx contracted with Cleveland State University to perform a state-wide fuel savings study of single-family site- built units weatherized during the 1985 program year (PY85). The study: (1) Explored fuel savings obtained by HWAP. (2) Measured cost effectiveness of those savings. (3) Measured the cost effectiveness of various combinations of weatherization measures. (4) Identified program benefits beyond fuel savings. The evaluation process continued in 1987 (Phase II) with the exploration of several factors that were not addressed in the initial study. The expanded evaluation measured: (1) overall program savings for up to three post-weatherization heating seasons; (2) the cost-effectiveness of various categories of weatherization measures based on consumption data for three post-weatherization heating seasons; and (3) the effects of lifestyle changes on fuel savings. Phase II also continued to explore subsets of data in an attempt to better understand factors that influence fuel savings as well as factors that confound the interpretation of study results. The long-range goal of Ohio's evaluation process continues to be the acquisition of information that can provide feedback to program operators and administrators that will help identify cost effective weatherization and conservation treatments. The ultimate goal of the state program is to reduce the cost of energy for low-income households while increasing household comfort. 11 refs., 4 tabs.

37059 (CONF-890845–, pp. 73-78) **Short-term energy evaluation program (STEEP) of the Illinois Weatherization program.** Kinney, L.F. (Synertech Systems Corp., Syracuse, NY (USA)); Sherman, D.B.; Haber, E.A.; Hastings, P.S.; Knight, P.A. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Six weatherization agencies in Illinois each weatherized 35 dwellings toward the middle of the winter of 1988-89. The weatherization work was accomplished as prescribed by a recently-developed audit system which estimates annual consumption of the dwelling and cost effectiveness for each weatherization measure. After initial weatherization work, 39 of the leakiest dwellings were further air sealed using information from blower doors. Savings, measured by weekly readings of elapsed time meters on each client's central heating system, averaged 16.3% or 21.7 million Btu's per year. Absolute savings for the quartile of dwellings with the highest before-weatherization heating energy consumption (adjusted for dwelling size and heating degree days) were 7.5 times the savings realized from the quartile with the lowest before-weatherization consumption. Although project findings are at present preliminary, the final results will be used to adjust audit software and modify several weatherization procedures. 9 figs., 2 tabs.

37060 (CONF-890845–, pp. 79-86) **Analysis of weatherization measures in low-income mobile homes.** Bournakis, A.D. (Univ. of Illinois, Chicago (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

This study assesses the effectiveness of energy conservation measures (ECMS) installed in mobile homes during the summer of 1986. The ECMS were based on new weatherization techniques developed by the Energy Resources Center (ERC) of the University of Illinois at Chicago (UIC) for the Illinois Department of commerce and Communities Affairs (DCCA) and presented in the Mobile Home Retrofit Handbook (Knight and Rangelov, 1986). Energy savings of 546 program participants, that had their mobile homes weatherized between May 1986 and September 1986, were assessed. In addition, energy consumption for a control group of 301 mobile home residents that had been approved for weatherization, but had not received weatherization assistance as of August 1987, were also assessed. Overall savings in aggregate normalized annual consumption was 6.5% (for all weatherized mobile homes having an R^2 of greater than 0.80). The overall control sample showed no changes in the energy use behavior of the mobile home residents. A statistical analysis to evaluate average energy savings and a cost-benefits analysis to identify the economic effectiveness of the various retrofit measures was performed. Changes

in energy consumption for the different climatic regions of the State of Illinois were also estimated. 6 refs , 3 figs., 4 tabs.

37061 (CONF-890845–, pp. 93-98) **High efficiency fluorescent lighting program: An experiment with marketing techniques to reach commercial and small industrial customers.** Clinton, J.M. (Barakat, Howard and Chamberlin, Inc., Washington, DC (USA)); Goett, A.A. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Niagara Mohawk conducted a truly unique experiment to test the effectiveness of alternative incentive levels, delivery mechanisms, and operational procedures for promotional conservation technology to commercial and industrial customers. The experiment was designed to compare three promotional approaches for high efficiency fluorescent lighting. The approaches were isolated geographically and consisted of a personal sales call, direct mail solicitation, and a promotion through lighting suppliers. Three different incentive levels were offered to the direct mail sample customers. Approximately 2500 were offered a rebate of $.80 per lamp for 4-foot and 8-foot, high efficiency fluorescent; 1300 received rebates of $.40 per lamp; 3600 received information on high efficiency lamps without the rebate offer. The program evaluation included both quantitative and qualitative analysis of the different approaches and the relative experiences, and an impact evaluation of customers' participation based on program and survey data. Costs and response rates are used to provide a bass for designing potential full-scale programs targeted to commercial and industrial customers. The experimental program tested the effectiveness of incentives, customer contact methods, and program operational procedures to encourage the accelerated adoption of high efficiency fluorescent lamps as a means for Niagara Mohawk Power Corporation (NMPC) to develop (1) effective energy service delivery and (2) motivational techniques for commercial customers. 2 tabs.

37062 (CONF-890845–, pp. 99-105) **The industrial lighting incentive program: Process and impact evaluation.** Wolfe, P. (Portland Energy Conservation, Inc., OR (USA)); McAllister, L. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

The Industrial Lighting Incentive Program was a three year pilot program developed by Portland Energy Conservation, Inc. (PECI) for the Bonneville Power Administration (BPA). It served high-bay industrial and warehousing facilities located in the Clark Public Utility District (Clark PUD) service territory in Clark County, Washington. The purpose of the program was to determine the cost of installing energy efficient lighting systems and to compute the energy savings resulting from the conversions. As an incentive, the participating utility customer was required to pay only an amount equal to the new system's first year energy savings. The balance was paid by BPA. A summary of program costs is provided in Table 1. Clark PUD assisted with the initial marketing and provided electrical histories for participating firms. Subsequent marketing was provided by participating lighting manufacturers' representatives and contractors. Lighting manufacturers' representatives performed lighting audits and designed the lighting systems. Local electrical contractors installed the systems. PECI trained contractors and manufacturers' representatives in program procedures. Using the data collected as part of the impact evaluation, it was not possible to demonstrate energy savings, due to unknown factors. 3 tabs.

37063 (CONF-890845–, pp. 107-112) **Electricity savings from a small C and I lighting retrofit program: Approaches and results.** Nadel, S. (American Council for an Energy-Efficient Economy, Washington, DC (USA)); Ticknor, M. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

A pilot lighting retrofit program for small commercial and industrial customers was offered by the Massachusetts Electric Company during 1985-1987. Under the program eligible customers received free energy audits and free installation of energy-efficient lighting equipment. The program was notable for its high participation rate: 60% of eligible customers received audits and 34% had efficient lighting equipment installed. An impact evaluation was conducted on the program in order to determine actual electricity savings achieved by the program and to experiment with different energy savings analysis methods. Four methods were employed: (1) engineering calculations: (2) comparison of pre- and post-program daily kwh use with a control group; (3) comparison of pre- and post-program daily kwh with a survey on changes in program participants, energy use patterns; and (4) conditional demand analysis. Methods 1 and 3 were found to be of questionable accuracy. Method 2 worked well in this study. Method 4 performed adequately although there were some difficulties developing regression equations with adequate explanatory power. Overall energy savings from the program were found to be appropriately 9% of participating customers pre-program electricity use. Recommendations on research to improve several of the analysis methods are made. 4 refs., 2 tabs.

37064 (CONF-890845–, pp. 115-119) **Integration of process evaluation and program design.** Evans, P. (Bonneville Power Administration, Portland, OR (USA)); Peters, J. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

The Energy $avings Plan (E$P) is a pilot program that offers incentives for industrial retrofit efficiency improvements. Sponsored by the Bonneville Power Administration (BPA) and the Region's utilities, E$P offers incentives to industrial manufacturers, processors, and refiners to install electrical energy efficiency improvements in their industrial processes. Process evaluations of previous industrial efforts provided the foundation for the E$P program design, and results of the E$P first year process evaluation indicate that the redesign has been successful. 3 refs.

37065 (CONF-890845–, pp. 121-125) **First year evaluation of the NEES cooperative interruptible service program.** Mystakides, E. (New England Power Service Co., Westborough, MA (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Interruptible rate programs are becoming increasingly popular among capacity-tight utilities. These programs not only provide scarce peaking resources, but also a way for utilities to diversify their services and offer lower energy costs to certain customers. New England Electric's Cooperative Interruptible Service (CIS) Program was launched separately in each of the system's three retail companies over the winter of 1987-1988. New England Electric System (NEES) is a holding company whose retail companies include Massachusetts Electric serving most of central Massachusetts, Narragansett Electric serving most of Rhode Island, and Granite State Electric serving a small portion of New Hampshire. The CIS Program involves contractual arrangements where large industrial and commercial customers agree not to exceed, on average, a designated kW level when requested on peak summer and winter days. Customers typically curtail operations to shed load or switch to their emergency generators during the interruption periods, which last from 6 to 10 hours each day. By the end of 1988, the program had 15 participants. The first year evaluation of the CIS Program covered several key areas: participation, customer satisfaction, compliance, load relief and cost-effectiveness. This paper will first describe, in detail, the CIS Program and its participants' characteristics. Key issues affecting satisfaction, from the customers' perspectives, will then be discussed. The evaluation assessed compliance rates for different customers, under different conditions, most notably consecutive day interruption,s. The paper

concludes by estimating the load relief achieved by the CIS Program and its cost-effectiveness. 2 refs., 1 fig., 2 tabs.

37066 (CONF-890845–, pp. 127-130) **Evaluating customer willingness to pay to avoid electric outages.** LeBlanc, W.J. (Electric Power Research Institute, Palo Alto, CA (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Results from a previous Pacific Gas & Electric Company survey indicated that customers had a wide variety of costs for power outages. This paper shares results of a subsequent market research project conducted to determine: (1) if the estimated outage costs predicted in the previous Value of Service mail survey were indicative of the investment customers would make to avoid outages; (2) if results were different, what were the causes: and (3) if a market existed for the utility to offer backup generation as a service option. The results showed that when a more detailed investigation occurred on-site with customers who had perceived outage costs exceeding the costs of owning and maintaining a hack-up generator (approximately $30/kw-year), estimates of outage costs were substantially lower and dropped to $0 in 40% of the cases. The interviews revealed that customers often have difficulty quantifying effects of hypothetical outages, and most customers expected no future outages, even though outages occurred periodically in the past. Future studies on the value of reliability might consider blending costs of an actual outage with costs for a hypothetical outage. In order to enhance the effectiveness of a backup generation program, curtailable or interruptible rate discounts should be available. 3 refs.

37067 (CONF-890845–, pp. 133-138) **Utilization of residential energy conservation program evaluation in least-cost utility planning.** Walsh, R.W. (Univ. of Vermont, Burlington (USA)); Aleong, J. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Utilization of residential energy conservation program evaluation in least-cost planning is explored through an analysis of 22 studies completed since 1983. Variations were found to exist in types of programs, objectives, and variables considered. Implications and approaches for meta-evaluation and meta-analyst is are discussed. 30 refs., 2 tabs.

37068 (CONF-890845–, pp. 139-142) **Danish programs for efficient use of energy.** Soerensen, B. (COWIconsult, Virum (Denmark)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

As in most industrialized countries, a number of programs aimed at increasing the efficiency of energy use have been established in Denmark since 1974. Examples include publicity campaigns, R&D efforts, financial incentives to developers, manufacturers and consumers, and differentiated taxation schemes. This paper discusses the prospects for carrying through an evaluation of these efforts, and identifies some elements to consider in such an evaluation. 10 refs., 3 figs., 1 tab.

37069 (CONF-890845–, pp. 143-150) **New Jersey conservation analysis project: Energy savings from residential programs.** Ozog, M. (RCG/Hagler, Bailly, Inc., Boulder, CO (USA)); Violette, D.; Sueker, J. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

The purpose of this paper is to discuss the method used to analyze a series of utility conservation programs mandated by the New Jersey State Legislature. The project is being conducted for the New Jersey Conservation Analysis Team (NJCAT). NJCAT is a consortium of the seven investor-owned gas and electric utilities in the state, the Board of Public Utilities, the Public Advocate, and the Energy Division of the Department of Commerce. This project is one of the largest conservation program evaluations undertaken, encompassing an integrated investigation spanning several utilities and several programs. Data collection alone involved several different firms working for more than one year. This project is noteworthy not only for the magnitude of the evaluation, but also for the innovative approaches used to estimate energy savings. These estimates are obtained by both statistical models and engineering models. The statistical modeling involves both discrete choice modeling and multivariate regressions, and is designed to address significant evaluation problems such as how to control for self-selection bias. The engineering simulation estimates energy savings by using building energy use analysis models. Combining the statistical model with an engineering simulation allows estimation of both total energy saved and reductions in peak demand. This paper will concentrate on methodology. The next section gives a brief description of the various conservation programs in this project. The discussion continues with an outline of the methodology used to evaluate these programs, addressing data collection, quantitative formulation, and concluding with an outline of the engineering simulation. 5 refs., 3 tabs.

37070 (CONF-890845–, pp. 155-161) **Residential direct load control: Comfort effects and predictors of load savings.** Kempton, W. (Princeton Univ., NJ (USA)); Reynolds, C.; Hull, D. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

In a pilot utility direct load control (DLC) program, air conditioners were remotely cycled in order to reduce electric load requirements. The load savings and comfort effects of the program are analyzed. A discomfort-from-cycling indices was constructed from participant logs reporting cooling adequacy. Based on both the discomfort index and reported internal temperatures, the DLC cycling did not create a comfort problem. Also, participants achieving higher load savings were not significantly more likely to report discomfort. Two variables which did significantly predict load savings were duty cycle and frequency of thermostatic cycling. Current DLC equipment uses a fixed cycle-off time, typically 25% to 50%. This fixed percentage can be based on a utility's average customer but cannot be tailored to the specifics of individual houses. On hot afternoons, 34% of the air conditioners in our sample were thermostatically cycling on for half or less than half of the time. Since the DLC equipment in this study cycled off only half the time, this 34% contributed to program costs yet could not provide load savings. The cost-effectiveness of DLC program could be improved with prescreening based on measurements of either duty cycle or cycling frequency. 9 refs., 8 figs., 1 tab.

37071 (CONF-890845–, pp. 163-170) **Evaluating utility direct load control programs: The duty cycle approach.** Smith, B.A. (Quantum Consulting Inc., Berkeley, CA (USA)); Braithwait, S.D. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

This paper presents research results of an Electric Power Research Institute (EPRI) research project, Design and Analysis of Direct Load Control Programs (RP2342-8), that has developed a generalized method for evaluating the impacts of direct load control (DLC) programs. This method is called the Duty Cycle Approach. Direct load control, the most often used demand-side management technique, has been adopted by a large number of utilities as an important part of their resource plans. A 1988 EPRI survey of demand-side management projects identified 361 utilities with active load management programs designed to cycle or shed the

load of various residential appliances through direct utility control. These utilities reported almost 1.5 million points of control for air conditioners and nearly 1.7 million points for water heaters. An important program evaluation issue facing utility planners is how to calculate reliable estimates of the load (kW) and energy (kWh) impacts of DLC programs that are needed to assess program cost-effectiveness. The paper describes one method, the Duty Cycle Approach (DCA), which is based on the analysis of appliance metered load data. The paper discusses both the strengths of the approach and empirical results obtained to date in applying it to DLC program data from the Athens (Tennessee) Utilities Board and the Atlantic Electric Co. The ultimate goal of this research is to develop an empirically based, transferable model of DLC program impacts that can be used by utilities to simulate potential load impacts under wide range of cycling strategies, weather conditions, and household characteristics. If successful, this model, called the Impact Prediction Model, will allow utilities who are considering DLC programs to predict the probable impacts of control strategies using only local weather data and appliance size data without having to collect end-use data. 3 refs., 10 figs.

37072 (CONF-890845–, pp. 171-175) **An evaluation of central Maine Power Company's pilot water heater cycling program.** Michelsen, L. (Central Maine Power Co., Augusta (USA)); Ecker, L.; Lawrence, D. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

As part of Central Maine Power Company's (CMP's) continuing effort to provide reliable electric service at the lowest possible cost, CMP implemented a Pilot Water Heater Cycling Program in July of 1987. Since CMP is a winter peaking utility, the Company wanted to install 1,000 control devices in a pilot program by November of 1987 in order to evaluate the effects of capacity reduction from December 1987 through March 1988. The results of the pilot program were used to examine the market for a cycling program, to assess the costs and benefit of controlling electric water heating load, and to determine the cost effectiveness of a full-scale program. Management wanted an evaluation of the Pilot Water Heater Cycling Program in May of 1988 making efficient data collection and analysis critical. The Pilot Water Heater Cycling Program provided a mechanism for testing the effectiveness of direct load control for water heaters. CMP installed load control devices on participants' electric water heaters to turn off the water heater when CMP needed additional capacity on peak winter days. CMP offered the pilot program to year-round, flat rate, residential electric water heating customers in two adjacent Maine towns within the Company's Brunswick District. Customers were selected if they had an electric water heating or space heating rate code or if they used over 500 kWh in any winter month. The primary purpose of the evaluation was to determine the feasibility and cost effectiveness of reducing peak demand through a direct load control program for 100,000 electric water heaters. CMP wanted the pilot program evaluation to: (1) Assess the market for a load cycling program. (2) Measure capacity savings resulting from load cycling. (3) Perform a cost-effectiveness study for a full-scale program. 2 figs., 5 tabs.

37073 (CONF-890845–, pp. 179-182) **Service quality study: Wisconsin Power and Light Company.** McKellar, B.J. (Wisconsin Power and Light Co., Madison (USA)); McKinnell, T.; Van Liere, K. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

During the past several years, Wisconsin Power and Light (WP&L) Company has been actively exploring a range of mechanisms for making the company more customer oriented. Customer satisfaction and a high quality of service are important goals to WPL. A key to serving customers effectively is to provide services that meet or exceed customer expectations. Service that exceeds expectations results in satisfied customers. When service does not meet customer expectations, dissatisfaction is likely to result. In a competitive environment, dissatisfied customers are likely to shift to other service providers. Background A major part of WPL's efforts for making the company more customer oriented included a systematic study of customer expectations about service and perceptions of WPL's current performance. The study also examined customers' satisfaction with WPL, customers' attitudes toward electric and gas rates, how customers interact with WP&L, and what experiences lead to dissatisfaction. Surveys were conducted in 1987 with random samples taken of residential, agricultural, commercial, industrial, and wholesale customers. This paper summarizes the key findings of that study, exploring what predicts overall customer satisfaction and customer attitudes. 1 fig.

37074 (CONF-890845–, pp. 183-187) **Measuring the value of customer service at Seattle City Light.** Shaffer, J.C. (Seattle City Light, WA (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Value. Service. Customer satisfaction. Customer needs and wants. These concepts have received renewed attention from American businesses in the 1980s and the electric utility industry has heard the call as well. In 1987, Seattle City Light (SCL), the largest municipal electric utility in the Pacific Northwest, began several broad initiatives to refocus on customer service. One of these, a project to measure the value of services to customers, began in 1988 and will be completed this year. The overall framework for SCL's Value of Customer Service Project (Project) and results from seven customer focus groups are described in this paper. Within SCL, a Utility-wide task force was created to work on this project. The task force includes researchers, customer contact staff, economists, engineers, program evaluators, and planners. The diversity, teamwork, and long-term commitment of this group has added enormously to the quality of the research design and the likelihood that project result will be utilized by the organization. The Project is being managed by SCL's conservation program evaluation unit. It is viewed as a global evaluation, crossing many divisions, rather than the type of program specific evaluation study generally conducted. Three perspectives on customer service are being examined. First, and of primary importance, is the customer perspective. This study is measuring the value of current and possible new services to residential and commercial customers. Further, customers are being probed for their level of satisfaction with services they have utilized or experienced. General attitudes toward SCL as a customer-oriented company are also being explored. The second perspective is the employee viewpoint. Lastly, the project is attempting to identify and dissect the corporate values for services. 1 tab.

37075 (CONF-890845–, pp. 189-193) **PG and E's value of residential services research.** Schuck, L. (Pacific Gas and Electric Co., San Francisco, CA (USA)); McNeil, E. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

This paper describes a research project being conducted by the Pacific Gas and Electric Company (PG&E) to better understand the expectations and perceptions of its residential customers in relation to a range of services offered by the company. In addition to determining the perceived value to customers of 30 services, the study will assess how service delivery characteristics affect customer satisfaction. PG&E plans to use the research results to tailor its service offerings to more closely and cost-effectively meet the needs of its various customer segments. The research is underway but not completed as of this writing, and this paper describes the methodology and questionnaire design. The Value of Residential Services (VORS) research focuses specifically on residential customers. The study has three major objectives: (1) To rank 30 customer services based on their value from the customers' perspective. (2) To understand how the delivery of services affects

customer satisfaction. (3) To identify customer segments that correlate most closely with different service preferences. Historically, the satisfaction of PG&E's 4.1 million residential customers has been extremely high. But because rate increases are anticipated during the next five years, the company is concerned about maintaining customer satisfaction. A major reason for conducting the VORS research is to identify the services which are most highly valued by customers and to understand how aspects of the delivery of those services, such as the concern and caring shown by employees, can affect customer satisfaction. The utility is also trying to minimize costs in order to hold rates as low as possible. A second reason for conducting the VORS research is to identify opportunities for cost reduction by eliminating or restructuring services that are of low value to customers. 4 refs., 1 tab.

37076 (CONF-890845–, pp. 195-200) **Using commercials to sell DSM programs: A measurement of customer response.** Birnbaum, I. (Barakat, Howard, and Chamberlin, Inc., Oakland, CA (USA)); Davis, T. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

This paper discusses methodological issues and results associated with an evaluation of program marketing materials conducted by Synergic Resources Corporation (SRC) for Gulf States Utilities (GSU). To a large degree, a DSM program's participation levels are influenced by the level and type of promotional activity. In this case, television commercials developed by GSU for the Good Cents Homes, Heat Pumps, and Security Lighting programs were tested for effectiveness among a representative audience using a new market research device - the Perception Analyzer (PA). The PA is a computer-based tool which enables testing of up to 60 individuals in a focus group-type setting, providing a combination of qualitative and quantitative information. Instantaneous results are provided which can be viewed on a monitor, while detailed findings are contained in the hard-copy output. Sixty GSU customers were recruited for the session. The group was designed to be representative of the utility's customer base in terms of sex, race, age, income, and energy use. The session was conducted in Beaumont, Texas. A series of background questions was asked related to the session participants' demographic characteristics and the types of energy used for space heating and water heating. The session participants were also asked to evaluate which form of energy used in the home provided the best overall value, and to rate the reliability of their electric service, and whether they planned to buy a home over the next few years. 2 figs., 2 tabs.

37077 (CONF-890845–, pp. 203-209) **An evaluation of carpooling projects at two Missouri rideshare programs.** Barnett, D.R. (Missouri Dept. of Natural Resources, Jefferson City (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Primary data collection (carpool surveys and vehicle occupancy count surveys) linked with secondary data analysis of federal and state publications were used to measure the impact of car pooling projects between 1980 and 1984 at ride share centers in the Kansas City and St. Louis Consolidated Metropolitan Statistical Areas (CMSA's). In 1989, the study was updated through 1988. Results noted that new carpool applicants decreased over time but did not directly affect carpool formation rates. Data seemed to indicate that as gasoline prices decreased, the numbers of people car pooling decreased. However, car pooling which was attributable to the two Missouri programs slightly increased. In addition, changes in the Civilian Labor force masked carpool statistics and could lead to erroneous results. Findings also showed that from 1980 to 1988 the Kansas City CMSA ride share center was credited for 1.26 to 3.36% of all area car pools while the St. Louis CMSA center was responsible for .55 to 1.52%. Gallons of gasoline and dollar savings attributable to the programs appeared significant. 22 refs., 8 tabs.

37078 (CONF-890845–, pp. 211-217) **Attrition bias in fuel savings evaluations of low-income energy conservation programs.** Blasnik, M. (Grass Roots Alliance for a Solar Pennsylvania, Philadelphia (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Common fuel savings evaluation methodologies require more consumption data than are available for many participants in low-income weatherization programs. These data requirements often lead to sample attrition rates greater than 50%. In the process of conducting a pilot weatherization program, the Grass Roots Alliance for a Solar Pennsylvania (GRASP) noticed substantial differences between houses which met the data requirements for evaluation (the evaluation sample) and those which did not (the attrition sample). GRASP compared the evaluation sample with the attrition sample and an unscreened sample in order to verify and quantify some of these differences and investigate the potential for bias caused by sample attrition. GRASP discovered significant differences between the evaluation sample and the other groups in terms of initial measured air leakage rate, reduction in leakage rate due to program measures and pre-period fuel consumption. The evaluation sample houses had significantly tighter envelopes than the unscreened sample and had much smaller air leakage rate reductions from weatherization measures. A rough comparison of fuel usage showed significantly lower consumption for the evaluation sample than the attrition sample. There appears to be a correlation between the quality of billing data and the thermal integrity of the house. These results imply that low-income weatherization programs may be achieving greater savings than a standard high attrition evaluation would indicate. GRASP's findings demonstrate attrition bias and call into question the generalizability of many low-income fuel savings evaluations which have comparable sample attrition. Further exploration is needed in evaluation methods which reduce this bias such as cruder billing data analysis techniques, statistical bias reduction techniques, and methods such as short-term submetering which create their own data. 10 refs., 2 figs., 2 tabs.

37079 (CONF-890845–, pp. 219-224) **Energy use and consumer dissimilarity in multifamily residential conservation.** White, D.L. (Oak Ridge National Lab., TN (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Residential conservation program evaluations are typically focused on energy savings and the variation in energy savings across units of analysis. This focus has become known as a two-stage approach to energy use analysis. In the first stage, customer energy use records are weather-adjusted. In the second stage, the weather adjusted energy use records are regressed upon a vector of housing and occupant characteristics. It is felt that controlling for the differences across units of analysis will yield a better estimate of the energy savings that can be attributed to the residential conservation program. This approach has worked well in the single-family subsector. However, the multifamily subsector poses problems that have not been uncovered in analyses of single-family conservation programs. For instance, analysts must control for vacancy on a scale that surpasses the concern about vacancies in single -family analysis. Furthermore, analysts must also determine the level of aggregation in the multifamily subsector that yields the better estimate of energy savings. Multifamily energy use analysis can be conducted at the unit or building-level. The level of aggregation has been shown to affect estimates of energy savings in multifamily conservation programs. For example, a study of energy savings due to Model Conservation Standards in new, low-rise multifamily buildings in Tacoma, Washington, has shown that savings estimates based upon different levels, of aggregation can vary by as much as 50%. This paper examines the issue of data analysis at different levels of aggregation. This paper further examines this unit of analysis issue by presenting an illustrative example

of the problems associated with aggregated analysis. It is concluded that aggregating data for alternative analyses involves significant additions to evaluation plans. 10 refs., 4 tabs.

37080 (CONF-890845–, pp. 231-236) **Some estimates of free rider proportions in demand-side management programs.** Fang, J.M. (Illinois Commerce Commission, Springfield (USA)); Lui, D.W. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

In the context of a utility sponsored demand-side management (DSM) program, free riders are those participants who would have installed, on their own in the absence of the subsidy offered through the utility program, exactly the same energy conservation measures as those being promoted by the program. The energy savings attributable to free riders would be realized without the subsidy and should not be attributed to the utility program. Thus, when there are free riders among participants of a DSM program, including the energy savings of all participants in the cost benefit calculations would overstate the real benefit of the program. It is important to estimate the extent of free rider participation in the program to properly conduct a cost benefit analysis of a conservation or other DSM program. There are few explicit estimates of free rider proportions. Morrison (1987) reviewed 70 studies of energy conservation program evaluations and found only eight specific estimates of free rider proportions. McRae et al. (1988) summarized 15 estimates for rebate programs, some of which were also included in the Morrison study. This paper presents estimates of free rider proportions derived from evaluating experimental programs implemented by Illinois utilities during 1984-87. The results of 20 programs by nine utilities were reviewed and compared with available estimates from other sources. The programs are grouped into four program types: rebate, loan, low income targeted, and other audit programs. This paper first discusses some concepts of free riders and then briefly explains the approaches used by Illinois utilities to derive estimates of free rider proportions. Available Illinois estimates are then presented and discussed by program type. Estimates from other sources are cited for comparison. 7 refs., 2 tabs.

37081 (CONF-890845–, pp. 237-240) **Program evaluation of the New York State Energy Efficient Appliance Rebate Demonstration Program: The free rider factor.** Saxonis, W.P. (New York State Energy Office, Albany (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

The New York State Energy Efficient Appliance Rebate Demonstration Program administered by the New York State Energy Office was designed to determine if financial incentives influence consumers to purchase energy efficient appliances. It was also designed to serve as a mechanism for retuning petroleum overcharge dollars to consumers in an expeditious manner. The program offered rebates from $50 to $125 for refrigerators and $35 to $75 for room air conditioners meeting the Program's standards for energy efficiency. The rebates were available to individuals living, buying, and installing an eligible appliance in seven counties located in both upstate and down state regions of the State. These regions represent broad geographical diversity as they include rural, suburban and urban areas. Consumers in the down state region pay electric rates which rank among the highest in the nation while the cost of electricity in the upstate region is only marginally higher than the national average. The Rebate Program awarded over 73,000 rebates ($5.6 million) between April 1, 1987, and May 21, 1988, and was the largest ever offered. The other programs were operated by the State's utilities primarily on a pilot basis. New York State evaluated the Rebate Program based mainly on the actions and attitudes of participating consumers and appliance dealers. The results discussed in this paper are only a portion of the completed evaluation report. This paper focuses on the analysis on the barriers to accurately determine the percentage of consumers who would have purchased the same appliance model even if the rebate were not available. These individuals are often referred to as free riders, and is a key statistic in assessing the effectiveness of appliance rebate programs. We examined the free rider factor from both the consumer and dealer perspective and discovered two radically different estimates. 6 refs., 1 tab.

37082 (CONF-890845–, pp. 241-249) **Correction for self-selection bias: Theory and application.** Violette, D. (RCG/Hagler, Bailly, Inc., Boulder, CO (USA)); Ozog, M. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Techniques for addressing self-selection bias are likely to become more important for researchers estimating the energy savings from conservation programs. The techniques for performing this correction are becoming well established and the procedures are relatively straightforward to implement. This paper attempts to bridge the gap between the theory and practical application of self-selection correction techniques, taken from the perspective of an applied conservation program evaluation researcher. While several selectivity correction methods are available, the paper focuses on a method developed by Dubin and McFadden (1984). One new application was of the technique and two recent applications (Train, 1988; and Train and Ignelzi, 1987) are discussed. These applications utilize different specifications of the energy savings model and, as a set, they are useful in demonstrating differences in the interpretation of the selectivity correction factor across different evaluation applications. This paper is divided into four sections: (1) an explanation of how self-selection bias arises and how it can affect program evaluation; (2) an explanation of the conditional expectation correction technique developed by Dubin and McFadden; (3) an analysis of how the technique has been applied in four separate cases; and (4) a discussion of practical lessons for researchers applying the technique. 10 refs., 5 tabs.

37083 (CONF-890845–, pp. 253-256) **An economic evaluation of efficiency improvements in residential water heating equipment.** Haeri, M.H. (ERC Environmental and Energy Services Co., Portland, OR (USA)); Lerman, D.I. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Marginal costs and benefits to the consumer of improved energy efficiency in residential water heaters are analyzed. Based on the information collected from 147 retail firms in the Northwest on 520 gas and electric water heater units, regression analysis is used to estimate the change in purchase price resulting from marginal gains in efficiency. The findings suggest that for the water heater with average efficiency, the incremental cost of a one point increase in Energy Factor could be recovered in 1.2 years for an electric unit and 1.5 years in the case of gas units. Study results are used to explore implications of the forthcoming 1990 federal efficiency standards. 3 refs., 2 figs., 4 tabs.

37084 (CONF-890845–, pp. 257-262) **Testing the effectiveness of a residential rebate program by tracking sales of appliances inside and outside the utility's territory: The case of Wisconsin Electric's 1988 Smart Money Program.** Brooker, R.G. (Wisconsin Electric Power Co., Milwaukee (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

As part of a multi-faceted evaluation of the 1988 Smart Money Energy Program, sales of refrigerators and room air conditioners were recorded. Sales were tracked during and after the program in the Appleton market (inside Wisconsin Electric's service Territory) and Green Bay market (outside the WE service territory). All appliance buyers were identified as being either WE or non-WE

customers. The Appleton and Green Bay markets were chosen because they are similar in size, demographic composition, and weather patterns. There was no rebate program in Green Bay. Virtually all the large stores were included in the survey so that the study measured at least 90% of the sales in each market. Data were recorded by salespeople after making sales. The salespeople completed one-page forms identifying the appliance sold (type, model number, size, etc.) and the customer (name, address, telephone number). In addition, surveys were conducted of all the refrigerators and air conditioners displayed on the showroom floors during and after the program. These surveys were used to measure availability of appliance models. 6 tabs.

37085 (CONF-890845–, pp. 263-269) **Evaluation of a residential appliance rebate program using billing record analyses.** Rogers, E.A. (Wisconsin Electric Power Co., Milwaukee (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Wisconsin Electric Power Company is providing financial incentives to customers who install energy-efficient appliances or turn in old, inefficient appliances. The purpose of the evaluation of the Smart Money program is to determine whether the specific components are cost-effective. The basic question asked by the utility management is: Are customers who participated in the program using less energy than they would have used if there had not been a rebate program? One method that is used to evaluate the energy effects of the residential rebate components is billing record. 3 figs., 2 tabs.

37086 (CONF-890845–, pp. 273-278) **Comprehensive evaluation: A commercial sector example.** Petersen, F. (Bonneville Power Administration, Portland, OR (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

The purpose of this paper is to present the benefits of designing evaluations that cover the broad picture. Often program evaluations are too narrow and focused on a limited number of issues. Not only is this not intellectually satisfying for the evaluator, but the program manager doesn't get the broad perspective of over all program achievement and interrelationship of program features. This paper advocates the use of complementary evaluations including: marketing evaluations, multi-stage progress evaluations, metering, as well as process and impact evaluations. The specific example used is the evaluation of Bonneville Power Administration's Commercial Audit Program. This $10 million program funded 15 contractors to perform 4000 commercial audits at three levels of complexity throughout the Pacific Northwest. To increase the usefulness of the evaluation several facets were designed at the beginning of the program. These included process and impact evaluation as well as progress evaluations to assess the success of program marketing. This paper provides specific examples of findings from individual evaluations. It then shows how those findings reinforce each other and contribute to a solid understanding of the overall program. 7 refs.

37087 (CONF-890845–, pp. 279-282) **Evaluation of Bonneville's commercial audit program.** Dagang, D.A. (Cambridge Systematics, Inc., Berkeley, CA (USA)); Train, K.E. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Through its Commercial Audit Program (CAP), the Bonneville Power Administration (BPA) has provided energy audits at no direct cost to eligible owners and operators of commercial buildings in BPA's service area. The buildings were divided into three audit levels according to their size and complexity. By 1988, approximately 3,800 commercial energy audits had been administered at a cost of more than $10 million to BPA. The goals of CAP were: (1) to develop and field test the minimum requirements for conducting commercial audits, and evaluate which type of contractors were best suited to the program; (2) to build a database using the information obtained from the audits; (3) to encourage, with incentives (in the planning stage only), the implementation of recommended ECM's; (4) to establish a cadre of qualified commercial auditors in the Pacific Northwest; and to conduct over 4,000 commercial energy audits. In addition to these four primary goals, CAP also established a secondary goal of inducting commercial buildings to implement conservation measures through the offering of no-cost audits. This paper describes the final results of a four year evaluation of CAP. In particular it examines the accuracy of the database, the cost of the audits, the extent to which recommended measures were installed, and issues relating to program implementation. As with any evaluation, many problems were encountered because the program was not designed with the evaluation in mind. We provide recommendations as to how future programs can be designed so as to avoid these problems. Accuracy of the CAP Database Each major component of the CAP data is discussed. 6 figs.

37088 (CONF-890845–, pp. 289-295) **Serving vital needs: An evaluation of the energy savings for nonprofits program.** Davis, R. (Washington State Energy Office, Olympia (USA)); Gibbon, P. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Nonprofit agencies are a sector of the building stock which has often been overlooked in energy conservation delivery and evaluation. This paper describes the elements of a conservation demonstration program for human service nonprofits in Washington State, focusing on program delivery, decision-oriented process evaluation, and case studies of two projects. 4 refs.

37089 (CONF-890845–, pp. 297-301) **Evaluation of the Utah Institutional Conservation Program: Preliminary results.** Miller, J.R. (Univ. of Utah, Salt Lake City (USA)); Vedadi, A. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Energy conservation programs often have explicit or implicit economic efficiency goals. While programs may be justified with sustainable society, environmental, or equity arguments, even the most hardened environmentalist or advocate for low-income households understands getting the most bang from the energy conservation buck. In this paper, part of a larger project funded by the Utah Energy Office (UEO), some preliminary results are presented from other evaluation of the Utah Institutional Conservation Program (ICP). This work was preceded by another project which identified program evaluation possibilities at the UEO and led to an evaluation of the Utah Weatherization Assistance Program (Miller, 1988; Miller, 1989). There is a large and growing literature on evaluation of residential energy conservation programs, but only a few studies of programs for institutional buildings (Davis, 1987; Utah Energy Office and Idaho Department of Water Resources, 1988). Institutional programs are much more difficult to evaluate. The main purpose here is to report preliminary estimates of percent savings in natural gas consumption due to energy conservation measures (ECMs) installed under the Utah ICP. As part of the larger project, savings in electricity consumption is measured, add this to the natural gas savings, and calculate the discounted present value of benefits and costs of the program. The eventual goal is to be able to compare these ICP results with those of our previous evaluation of the Utah Weatherization Assistance Program. Comments are also made on the evaluation problems and challenges encountered. ICP percent natural gas savings are compared under three different methodologies: PRISM, FASER, and an internal UEO method. 7 refs., 3 tabs.

37090 (CONF-890845–, pp. 303-308) **Case study analysis of the institutional buildings program in Washington State.** Kunkle, R. (Washington State Energy Office, Olympia (USA)). Argonne

National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

From September 1988 to June 1989, the Washington State Energy Office (WSEO) conducted case studies of 50 institutions which participated in the Institutional Buildings Program. This report describes the approach used for the case studies, reviews WSEO's experiences conducting the project, and summarizes preliminary results from the first 36 cases. From 1982 to 1987, the Bonneville Power Administration (BPA) relied upon its Institutional Buildings Program (IBP) to purchase electric energy conservation from schools, hospitals, governments, and special districts throughout its four-state service territory. The program provided incentive payments to eligible institutions to install cost-effective energy conservation measures. In BPA's four-state service territory, conservation measures for 348 institutions were funded at a total cost to BPA of $34- million. The IBP in Washington served 121 institutions, helping to finance 1050 energy improvements at a cost to BPA of about $15.35 million. The BPA incentives paid a little over 70% of actual installed costs for the energy conservation measures (ECMs) in Washington State. In 1987, WSEO performed an overall impact evaluation of the IBP in Washington State. Screening of the sample to account for missing data, one year of ECM operation, or changes at the institution reduced the final sample to 40 buildings. The analysis found that changes in building energy use (based on one year of pre- and post- ECM utility data) were less than predicted - between 69% and 82% of the engineering estimates. The impact evaluations, which dealt with aggregate analysis, could not address these issues. Actual ECM performance is dependent on site specific circumstances, which are difficult to capture with statistical models. The results presented in this report are based on the first 36 case studies. Some institutions had more than one facility included in the program. 9 refs., 1 fig., 2 tabs.

37091 (CONF-890845–, pp. 311-316) **Persistence of energy savings in Seattle City Light's residential weatherization program.** Sumi, D.H. (Seattle City Light, WA (USA)); Coates, B. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Evaluations of energy savings for conservation programs tend to be single snapshots of program effects, typically including a single year of post-program consumption data. Depending upon the uses of such evaluation results, this can result in over-estimation of long-term impacts, or it may overlook delayed or persisting effect of the program. In either case it is unlikely that program induced savings are constant over time. The research described in this paper examined the consumption for homes weatherized by Seattle City Light's Home Energy Loan Program (HELP) during the years 1981 through 1986. HELP was created to provide weatherization loans to residential customers who reside in single-family to fourplex units and heat their homes with electricity. City programs have weatherized approximately 17,000 homes since 1981 (including low income and duplex to fourplex housing), of which HELP has weatherized approximately 9,000 residences. Financing in the HELP program is provided for: ceiling, wall, floor, heating duct, water heater and pipe insulation; insulated glass or storm windows; caulking and weatherstripping; and automatic clock thermostats. In order to participate in the program, installation of some of the measures is mandatory. Although there has been some variation in optional measures across the years of this evaluation, the mandatory measures have consistently included: ceiling insulation to R-38; crawl space insulation to R-19; and hot water tank wraps to R-10. The primary purpose of the analysis is to estimate HELP participants' energy savings over the period 1982 through 1987, focusing on the durability or, conversely, the erosion of savings over time. This information was used to revise load forecast assumptions for electricity savings attributable to the HELP program in the forecast period (through the year 2010). 7 refs., 2 tabs.

37092 (CONF-890845–, pp. 317-320) **The persistence of energy savings over time: Two and three years after participation in a retrofit program.** Brandis, P. (Bonneville Power Administration, Portland, OR (USA)); Haeri, M.H. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

This paper analyzes the trends in energy savings achieved through Bonneville's weatherization programs since 1980 and examines the persistence of these over time. Five retrofit program, including four cohorts within the Long-Term Residential Weatherization Program and one in the Hood River Conservation Project, are considered. The results show a declining trend in energy savings and steadily increasing conservation costs. In spite of increasing costs to the region, Bonneville's weatherization efforts have managed to produce electricity savings at prices well below the regional cost effectiveness limit of 55 mills per kwh. The results concerning the stability of savings remain inconclusive. 11 refs., 1 fig., 2 tabs.

37093 (CONF-890845–, pp. 323-331) **Toward a common method of reporting and comparing results from evaluations of residential conservation programs.** Schlegel, J. (Wisconsin Energy Conservation Corp., Madison (USA)); Pigg, S. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

This paper proposes a standard method for reporting the results of evaluations of residential conservation programs in heating climates. Our motivation comes from the difficulty we have encountered in trying to compare the evaluation results of otherwise similar conservation programs that are simply reported differently or incompletely. Establishing a common protocol for reporting the results of residential conservation program evaluations will also make it easier to gauge the applicability and potential cost-effectiveness of a program conducted in one region with certain housing stock, climate, and economic conditions to another region with different conditions. In this paper we outline the critical information needed to assess the performance and cost-effectiveness of a residential conservation program. We also show how differences in reporting can make it difficult to compare the results of otherwise similar conservation programs. Finally, we explore energy consumption, energy savings and expenditure indices that will make it easier to compare the evaluation of programs conducted in different regions. 6 refs., 1 fig., 2 tabs.

37094 (CONF-890845–, pp. 333-337) **Cost-effectiveness enlightenment: Which is the right test?.** Herman, P. (Barakat, Howard and Chamberlin, Inc., Oakland, CA (USA)); Chamberlin, J.H. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Ever since its beginnings, demand-side management (DSM) has evoked arguments concerning the appropriate cost-effectiveness criteria in the selection of programs. This paper begins with a definition of the commonly used cost-effectiveness tests, and discusses the points of view represented by each in terms of efficiency and their impacts on equity. Next, an example is given demonstrating the implications of program selection under each test for a hypothetical utility. Finally, a methodology for DSM selection is proposed which acknowledges both the efficiency and equity impacts of the programs. Five main tests are used to measure the cost-effectiveness of demand-side programs in use across the nation. Each represents a different point of view on the efficiency or least cost of a DSM program. They go under different names in different parts of the country, but the names used in the California Standard Practice are: (1) The Participant Test (2) The Rate payer Impact Measure Test (3) The Total Resource Cost Test (4) The Utility Cost Test (5) The Societal Test Each is discussed.

37095 (CONF-890845–, pp. 339-345) **Evaluating the cost-effectiveness of a commercial and industrial conservation program.** Rogers, E.A. (Wisconsin Electric Power Co., Milwaukee (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Wisconsin Electric Power Company is providing financial incentives to customers who install energy efficient equipment or processes. In the first two years of the program (1987 and 1900) over 8000 commercial and industrial customers participated in one or more components of the program. The evaluation of the energy and demand effects of the Smart Money program includes three activities: program monitoring, end-use metering, and billing record analysis. Once the energy and demand effects of the program are quantified the cost effectiveness of each project can be analyzed using standard integrated planning techniques. 3 figs., 1 tab.

37096 (CONF-890845–, pp. 349-354) **Variability in commercial markets and implications for program transferability.** Kreitler, V.L. (Synergic Resources Corp., Bala Cynwyd, PA (USA)); Prahl, R. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Recently, much attention has been given to the concept of least-cost planning for utilities. The intent of the least-cost planning effort is to develop an approach for optimizing the usage of supply-side and demand-side resources in meeting regional energy needs. Under a least-cost framework, the value of supply-side and demand-side alternatives is compared using a methodology which provides an equitable and complete appraisal of costs and benefits, enabling planners to priorities available alternatives and compile a least-cost plan. This study was designed to provide information on market acceptance of an array of conservation measures, to assess preferences for alternative information and incentives programs, and to define key market segments on the basis of attitudes toward energy-related issues. As any practitioner in DSM is aware, eligible customers differ in their responses to utility programs. Analyses which segment eligible market into distinct groups attempt to capture this heterogeneity in ways relevant to the planning or marketing problem at hand. Such an analysis should identify groups or segments which differ in terms of their acceptance of DSM programs, should be able to characterize the reasons for the varying acceptance levels, and should provide some estimate of the magnitude of the differences in acceptance levels. This study has identified market segments on the basis of attitudes and opinions related to energy management. By defining sets of customers who share common opinions about energy management, utility programs, key equipment selection criteria, and so on, the segmentation will help utilities identify target markets as well as the appropriate strategies for each market. A key question in DSM planning and evaluation is the degree of transferability of successful programs or marketing strategies. 1 fig., 2 tabs.

37097 (CONF-890845–, pp. 355-360) **Shooting with a moving camera: Trends in commercial buildings energy consumption, 1979 through 1986.** Goldberg, M.L. (Energy Information Administration, Washington, DC (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

The Nonresidential Buildings Energy Consumption Survey (NBECS) is a national survey of commercial buildings conducted triennially by the Department of Energy. The statistics published from the NBECS include several indices of energy consumption and expenditures in commercial buildings, broken down by detailed building characteristics. This data set would seem to be ideal for analysis of trends in commercial energy consumption. While the NBECS does in fact offer a detailed picture of the dynamics of energy use, difficulties in interpreting the survey results arise from changes in the way the survey has been conducted. In this paper, these changes are described, and their implications are discussed in the context of an attempt to adjust the NBECS time series to a consistent basis for comparisons. Energy consumption data from the 1986 NBECS were published in May of this year (EIA, 1989). The 1986 NBECS was the third in the series, with previous surveys conducted in 1979 and 1983 and a fourth cycle to be fielded in the Fall of 1989, under the new title of Commercial Buildings Energy Consumption Survey (CBECS). The lower energy intensities for more recently constructed buildings suggest a trend toward lower consumption rates across the population of buildings. However, the electricity intensity is still higher in newer buildings than the overall population average, indicating that the addition of more such buildings to the stock will continue to raise the overall level. For natural gas, on the other hand, the intensity of recent construction is lower than that of older buildings, so that if these construction trends persist declining overall rates would be expected over time. Even with a downward trend by building vintage, though, energy intensities could be increasing in existing buildings over time. 8 refs., 3 figs., 1 tabs.

37098 (CONF-890845–, pp. 365-371) **Are high-participation residential conservation programs still feasible? The Santa Monica RCS model revisited.** Kushler, M. (Michigan Public Service Commission, Lansing (USA)); Witte, P.; Ehlke, S. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Faced with impending policy questions concerning the future of residential conservation services, Michigan decided to pilot-test an aggressively marketed home energy audit program. Building upon the previously successful Santa Monica Energy Fitness program, the Michigan Energy Fitness Program featured a two-person audit team and the direct installation of up to six low-cost conservation measures. Designed to incorporate a comprehensive program evaluation, project results to date have exceeded all expectations. Participation rates for the targeted areas in five different cities have averaged 49% across all types of usually difficult to-reach demographic groups. Material installation rates have ranged from 50% to 84% across the six measures. Costs per audit were found to be competitive with the standard RCS program. This paper presents and discusses these and other results. 13 refs., 2 tabs.

37099 (CONF-890845–, pp. 373-379) **Assessment of state needs for information and technical assistance in planning and evaluating residential energy conservation programs.** Vories, R. (Infinite Energy, Denver, CO (USA)); White, D.L. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

The purpose of this needs assessment was to assist the Department of Energy's (DOE) Residential and Commercial Conservation Program (RCCP) in determining the types of ongoing assistance that might be useful to organization as such as State Energy Offices (SEO), Public Service Commissions (PSC), and utilities. DOE planned to use this assessment to set priorities for its new projects and technology transfer activities, and identify other organizations to work with in meeting some of these needs. DOE had concluded that with the expiration of the Residential Conservation Service (RCS) program in June of 1989, it was time to take a look at the range of programs states and utilities are implementing in the area of residential conservation programs. Because RCCP responsibilities also include conservation in the small commercial sector, some effort was made to look at programs affecting this sector as well. Sixty representatives of SEOs, PSCs and utilities in 20 states were interviewed by phone to determine their current uses of, and future needs for, information and technical assistance sources in planning, implementing and evaluating conservation programs. This paper will cover the results of the survey and describe how RCCP

is using the information in its own planning activities. The 20 states interviewed include 13 states chosen by the General Accounting Office (GAO) for an evaluation of programs funded by Petroleum Violation Escrow Account (PVE) funds, plus seven additional states selected to provide regional balance. The states interviewed in each region are shown. 1 fig., 4 tabs.

37100 (CONF-890845–, pp. 383-388) **An investigation of commercial and industrial utility demand-side management program impacts.** Rufo, M.W. (Xenergy, Inc., Oakland, CA (USA)); Bester, N.L. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Among its numerous responsibilities, the California Energy Commission (CEC) is required to develop a state wide, long-range energy demand forecast in order to determine the need for new energy resources. As part of this process, the CEC solicits information on the impacts of conservation and load management programs from each of the State's utilities. The purposes of the research described in this paper were to analyze demand-side management (DSM) program impacts in the commercial and industrial sectors reported by California utilities for the years 1985 to 1987 and, as a result of this analysis, to recommend improvements in the characterization of these utility programs for the latest forecast. The primary purpose of this study was to assist the CEC in characterizing the factors that underlie utilities' estimates of the impacts of their DSM programs. This was necessary because the information reported to the CEC varies both in format and detail across utilities and over time. A variety of factors may affect impacts without being transparent in the reported data. Some of these factors include the use and magnitude of net-to-gross ratios, energy-to peak impact conversions, the separation of commercial and industrial savings, and the analytical techniques used to develop both net and gross impacts. 20 refs., 3 tabs.

37101 (CONF-890845–, pp. 389-394) **Design assistance for new commercial buildings.** Dethman, L. (Dethman and Associates, Seattle, WA (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Since November 1986, the Washington State Energy Office (WSEO) has provided Design Assistance for New Commercial Buildings. Design Assistance, funded by the Bonneville Power Administration, matches commercial developers and their design teams with energy consultants who are experts in computerized energy modeling and energy efficient building design. These experts, hired by the program, work directly with project decision makers to analyze energy use, and to identify and recommend energy saving strategies in the proposed buildings. Energy Office staff oversee project progress and review final reports for accuracy and completeness. Participants are not required to install recommended energy strategies; however, they are asked to seriously consider them. Twenty-one Design Assistance projects - those undertaken in the first year of program operation - are focused upon in this evaluation. This research - based on program records and interviews with program staff, consultants, and participants - evaluates whether a design assistance approach can effect positive changes in energy saving awareness and behaviors. This paper couples aggregated ratings with qualitative analysis of open ended questions, allowing general findings to be bolstered by the depth and color of explanations, examples, and quotations. A variety of outcomes, the secret of program success, and recommendations resulting from this research are discussed. To evaluate Design Assistance, Dethman & Associates reviewed program records and reports, talked with program staff, and conducted in-depth interviews with the energy consultants and with the participants - owners or their representatives, architects, and engineers. These interviews encompassed all of the major actors in the Design Assistance projects. 7 tabs.

37102 (CONF-890845–, pp. 397-405) **Evaluating energy and non-energy impacts of energy conservation programs: A supply curve framework of analysis.** Vine, E. (Lawrence Berkeley Lab., CA (USA)); Harris, J. Argonne National Lab., IL (USA). [1989]. DOE Contract AC03-76SF00098. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Historically, the evaluation of energy conservation programs has focused primarily on energy savings and costs. The recent, increased interest tin global environmental problems (e.g., acid rain, ozone depletion, and the greenhouse effect) has made decision makers, as well as program evaluators, sensitive to the environmental impacts of all programs, including energy conservation programs. Economic impacts of programs remain important policy concerns. Many state and local jurisdictions are concerned with the net effects of energy policies on economic growth, jobs, and tax revenues, as well as the impacts of growth and developments on local energy issues (e.g., construction of new power plants). Consequently, policy makers need a methodology to compare easily the energy and non-energy impacts of a specific program in a consistent way, for both retrospective analysis and for prospective planning. We present the general concepts of a proposed new approach to multi-attribute analysis as an extension of the concept of supply curves of conserved energy. In their simplest form, energy conservation supply curves rank and display the savings from conservation measures in order of their cost-effectiveness. This simple concept is extended to reflect multiple decision criteria and some important linkages between energy and nonenergy policy decisions (e.g., a supply curve of reduced carbon emissions, or a supply curve of net local job-creation). The framework is flexible enough so that policy makers can weigh and compare each of the impacts to reflect their concerns and see the results in terms of program rankings. The advantages of this analysis framework are that it is simple to use, flexible, and replicable. 14 refs., 6 figs.

37103 (CONF-890845–, pp. 407-411) **Evaluating community energy management strategies using the options model.** Laitner, S. (Economic Research Associates, Lincoln, NE (USA)); Kegel, J. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Over a two-year period, from 1985 though 1986, the Sioux Center Municipal Utilities spent more than $650,000 in a comprehensive energy management demonstration project. Efficiency investments completed in this town of 4,600 people ranged from heat recovery measures for the municipal swimming pool to installation of an extensive load management system. The payback period for the two-year effort in Sioux Center is estimated to be 3.6 years - clearly a positive return for the community. But other questions remain: Were there other benefits from the project beyond a reasonably short payback period? And given its range of opportunities, did Sioux Center spend its funds in a way that really added to its employment base and economic activity? The purpose of this paper is two fold: (1) to evaluate the Sioux Center energy management project relative to other community goals in addition to energy savings; and (2) to determine if a more ideal investment program might have been pursued. The OPTIONS model was used to analyze the impacts of both those measures which were completed and those which were not. It was then used to determine the ideal mix of efficiency measures that best promotes all of the identified goals rather than simply the payback goal. The heart of the OPTIONS model is what is known as the goal programming technique. The use of energy is not a goal in itself. Ideally, energy use ought to be managed in a way that promotes a variety of goals typically found within any community. 5 refs., 4 tabs.

37104 (CONF-890845–, pp. 413-418) **Energy program evaluation using P/G% decision-aiding software.** Stanton, T.S. (Michigan Public Service Commission, Lansing (USA)). Argonne

National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

The purpose of this paper is to evaluate different options for the next generation of electric power supplies for the state of Michigan. The analysis employs a multi-criteria decision aiding software system called P/G%. The primary objective is to compare three widely divergent power plant options for the next generation of electric power supply technologies for Michigan, to achieve the equivalent of 675 MW of new supply. The options are: (1) a modern but traditional coal fired power plant; (2) several thousand microcogeneration units based on automobile engines; and (3) a conservation power plant utilizing more efficient energy end-use equipment. Those alternatives are compared with respect to 20 different goals or objectives, including economic, environmental, employment, and other factors in addition to the primary energy supply criterion. The need for multi-criteria analysis of energy systems has become increasingly apparent in recent years, and is the essence of Least Cost Utility Planning or Integrated Resource Planning (NARUC, 1988). In the Michigan Electricity Options Study (Report 6-C, 1987), a multi-criteria analysis was used to compare different scenarios for their impacts on several so-called externalities-including employment, the environment, and aggregate Michigan industrial demand-in addition to direct economic effects. The most compelling comparison was between the scenario designed to minimize environmental impacts versus the scenario designed to minimize direct costs. 8 refs., 2 tabs.

37105 (CONF-890845–, pp. 421-425) **The promotion of residential energy-efficient lighting: Results of Massachusetts Electric Company's Enterprise Zone Plan.** White, D.S. (New England Power Service Co., Westborough, MA (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

The Massachusetts Electric Company's (MECo) Enterprise Zone Plan was a multifaceted energy conservation program targeted at 22 economically-depressed communities. For the residential class, there were two general thrusts to the program. First, all customers were eligible to receive free home energy audits and, if the household was low income 3 all cost-effective electric saving measures (from MECo's perspective) were installed free-of charge. A second thrust of the program was in the area of energy-efficient lighting. All customers had the option to purchase energy-efficient indoor and outdoor lighting directly from MECo. In addition, low income households were given energy-efficient compact fluorescent lamps free-of-charge at the time of a home energy audit. The purpose of this paper is to discuss some of the findings of market research that has been carried out for purposes of determining customer satisfaction with the energy-efficient lamps, usage of the lamps, reasons for purchase, and demographic, or attitudinal characteristics of participants that appear unusual or distinctive. Using the survey results, a test of the program's cost-effectiveness from various perspectives (utility, participant, and society) is presented. 1 fig., 5 tabs.

37106 (CONF-890845–, pp. 427-432) **Factors affecting response rates in commercial and industrial customer surveys.** Van Liere, K.D. (HBRS, Inc., Madison, WI (USA)); Rathbun, P.R.; Tannenbaum, B. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Utilities and public service commissions have become increasingly interested in learning about the commercial and industrial (C&I) class customers they serve. A growing number of utilities are sponsoring surveys of C&I customers. Although the research is similar in many ways to that done with residential customers, it is more difficult to gather data from C&I customers. Collecting survey data from C&I customers, by mail or telephone, is generally more difficult than collecting information from residential populations for several reasons. First, C&I organizations are very diverse in their size, structure, and functions. This makes it very difficult to design a generic questionnaire that can be used across different types of businesses. Second, the information collected from customers is often more technical and complex than the collected in residential surveys. Thus, the amount of time and effort required by a C&I respondent may be substantial. Third, it is often difficult to identify a single appropriate person within a company to complete the questionnaire. Because of these obstacles, many researchers assume that high quality C&I data bases require on-site interviews. While on-site data collection methods probably do offer the best method for careful enumeration of physical characteristics and end-use information, other survey techniques, such as mail questionnaires and telephone interviews, can offer reasonable detail at significant cost advantages. The purpose of this paper is to review and summarize what we have learned about the factors that seem to have the greatest impact on response rates to C&I surveys. 6 tabs.

37107 (CONF-890845–, pp. 435-441) **Integrating process and impact evaluation findings to modify the oil help rebate measure list.** Schueler, V. (Washington State Energy Office, Olympia (USA)); Davis, R.; Risman, M. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Designers of incentive programs for residential energy conservation can face a trade-off between maximizing cost-effective energy savings and simplifying program design in order to minimize delivery costs and eliminate potential barriers to participation. The Washington State Energy Office's (WSEO) experience with the Oil Help Demonstration (OHD) typified this trade-off. The program used a straightforward application and rebate and relied on the suppliers of Oil Help retrofits (especially fuel oil dealers) to assist in marketing. The program served a large number of people in a short time but was not as cost effective as it could have been, since more than three-quarters of the rebate money was spent on new oil furnaces - the least cost effective measure. In 1988, the WSEO evaluation team conducted process (Risman and Schueler, 1989) and economic (Davis, 1989) analyses of Cycle 1 of the program, which ran from September 1987 to June 1988. In this paper, we elaborate on the findings from the process and economic analyses and discuss how these findings were integrated to assess five alternative rebate structures for Cycle 2 of the demonstration. We conclude with a discussion of how the simplicity versus cost-effectiveness trade-offs made for the Oil Help Demonstration may be applicable to other rebate-based incentive programs. 7 refs., 4 tabs.

37108 (CONF-890845–, pp. 445-449) **Views and opinions on energy programs and services: Results of focus group interviews with low-income hispanics, blacks, and senior citizens.** Hall, N.P. (Illinois Dept. of Energy and Natural Resources, Springfield (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

During the winter of 1988, the Illinois Department of Energy and Natural Resources (ENR) conducted a series of six focus group interviews with specific segments of the low-income residential population to identify attitudes and opinions pertaining to energy consumption and conservation. The target groups selected for study included senior citizens and members of the black and Hispanic communities. These three groups were selected because of their history of under-representation in State operated energy conservation programs and because of the limited information available pertaining to the marketing of programs to these populations. The use of focus groups to obtain information from the clients who use or might potentially use a product or service has

been practiced for years. The methodology is fairly standard, simple, and straight forward. In general, a group of eight to twelve people, having at least one similar identifiable characteristic (age, sex, income, national origin, product need, etc.), meets to discuss a particular product, service, need, or concern. Moderators conducting the focus groups collect the opinions, tabulate the frequency and strength of the opinions, and draw conclusions applicable to a product, service, or other research goal. The information is tabulated, analyzed, and summarized into written reports, usually used to plan, improve, or market a product or service. Focus group interviews are also used to field-test a new product, service, or marketing idea. The importance of using focus groups is in the quality and strength of the opinions obtained.

37109 (CONF-890845–, pp. 451-456) **Limited-income elderly: Implications for program design and implementation.** Markee, N.L. (Univ. of Nevada, Reno (USA)); Murray, C.I.; Pedersen, E.L. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Planning and or refining energy conservation programs can be facilitated by utilizing market research techniques to identify appropriate market segments and collect information on targeted populations. The elderly have been identified as an under-served segment with regard to residential conservation programs; few programs have been specifically designed to reach this group. The purpose of this paper is to analyze data on Nevada LIHEA (Low-Income Home Energy Assistance) recipients age 60 and over, as these individuals represent 55% of the households receiving LIHEA funds in this state, and to determine effective approaches to take in planning future energy conservation programs that will attract this audience. 9 refs., 5 tabs.

37110 (CONF-890845–, pp. 457-464) **Comparison of alternative segmentation approaches for residential customers.** Van Liere, K.D. (HBRS, Inc., Madison, WI (USA)); McKinnel, T.A. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

As the role of demand-side management in electric utilities expands, there is greater pressure to develop programs that effectively attract customers and meet utility energy and load objectives. In their efforts to achieve these goals, utilities have turned to market segmentation as an important tool. Market segmentation basically involves dividing a diverse population of customers into relatively homogeneous groups. The objective of segmentation is to identify groups that have similar levels of demand for a service and similar reasons for that demand. Market segmentation is being used by utilities to inform a variety of business decisions. At the very early stages of developing programs, a utility uses segmentation to provide general market understanding. This provides a broad-based grouping to organize their approach to marketing services. Later, segmentation can be used to evaluate new program concepts and services. This occurs when program managers use a segmentation study to assess the size of a target audience for a program and the feasibility of reaching the audience with a particular marketing strategy. Segmentation studies are used to develop the marketing strategy for a particular program. In evaluating segmentation approaches, there are three key criteria which define a useful segmentation. First, the customer groupings should be correlated with some behavioral criteria of interest to the utility. Second, the customer groupings should be systematically related to one or more marketing-relevant variables. The third criterion used to define a successful segmentation is that the segments should differ in their cost for achieving a sale. The segments should produce some cost efficiencies in the allocation of marketing resources. The purpose of this paper is to compare three commonly used approaches to segmentation in terms of their ability to meet these three criteria. 1 fig., 6 tabs.

37111 (CONF-890845–, pp. 467-473) **Evaluation of California's Energy efficient building standards: The residential building monitoring project.** Warner, K.L. (Xenergy, Inc., Oakland, CA (USA)); Messenger, M.; Wilcox, B. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

The California Energy Commission has initiated an evaluation of its energy efficiency standards for residential buildings. A two year data collection and analysis project has been designed to calibrate and identify potential needed changes in the modeling assumptions used to determine the energy budgets required by the standards. The project will employ a three-stage nested survey using mail, on-site, and instrumented monitoring techniques to describe the physical and behavioral characteristics of new homes and their occupants. This paper presents the research plan for the project and discusses methodological issues relating to the integration of broad coverage mail survey data with high resolution metering data. The analysis plan includes house-by-house comparisons of PRISM results with simulation model predictions, and conditional demand analysis that utilizes the metered data using a technique known as mixed estimation. 4 refs., 3 figs.

37112 (CONF-890845–, pp. 475-480) **Estimation of the incremental cost of constructing super good cents homes: Methodology and results.** Cody, B. (Bonneville Power Administration, Portland, OR (USA)); Horowitz, M.J.; Jennings, J. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

The Bonneville Power Administration (BPA) operates a Super Good Cents (SGC) Program to promote the Model Conservation Standards (MCS) for energy efficiency in electrically heated homes. To determine the incremental cost of constructing a SGC home compared to homes built to current practice in each of the three climate zones in the BPA service area, cost data were collected from a sample of SGC builders based on cost estimates from their suppliers and subcontractors. The information was collected for three theoretical MCS prototype homes and for a home actually constructed by the builder in 1988 as well as for four current practice comparison homes. Current practice is defined as including those energy efficiency measures and specifications that would ordinarily be used by a builder when building a conventional, non-MCS house. The average cost to the builder in meeting the administrative requirements for certifying a SGC home was approximately $220. In adding these administrative expenses to the additional construction costs of the prototype homes, the average total incremental cost for building a SGC home was about $1640. 8 tabs.

37113 (CONF-890845–, pp. 481-487) **Residential energy efficiency and fuel choice.** Lee, A. (Pacific Northwest Lab., Richland, WA (USA)); Englin, J.; Harkreader, S. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

This evaluation involved the Bonneville Power Administration's (BPA) Early Adapter Program (EAP), which promotes early adoption of the Northwest Model Conservation Standard (MCS) for new residential buildings heated with electricity. The energy efficiency improvements required by the MCS are likely to increase construction costs and possibly reduce demand for new electrically heated homes. The purpose of the evaluation was to provide a preliminary assessment of fuel preferences and how the MCS affects residential fuel choice. A survey of households in two EAP regions was conducted and analyzed. Housing sales price data were collected in Tacoma, Washington, and hedonic price analysis was used to determine the effect of the MCS and different fuel types on housing price. Focus groups were held with Tacoma builders, and conjoint analysis was used to determine what factors most influenced the

installation of a specific fuel. The results showed that homeowners consider several fuel characteristics to be important in their fuel choice. Analysis of sales price data in Tacoma showed that buyers had paid more for gas-heated homes in recent years, probably reflecting recent sharp increases in the relative price of electricity. In addition, it appeared that buyers in Tacoma had paid considerably more for homes built to the MCS than electrically heated homes built to previous standards. Builder information suggested that buyer preferences were the main factor determining what fuel a builder would install. 7 refs., 1 fig., 3 tabs.

37114 (CONF-890845–, pp. 497-509) **Making conservation profitable: Issues for regulation and evaluation.** Sissine, F. Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Since the early 1970s, a combination of concerns has spawned a variety of energy conservation programs. These concerns include national energy security, environmental impacts, and accelerating construction costs for central station power plants. In the last few years, a major thrust of conservation programs has been channeled through state regulations creating least-cost planning programs and utility initiatives creating demand-side management activities. In general, least-cost plans seek to put end-use efficiency improvements and load management activities on an equal economic footing with more traditional supply-side resources. Demand-side management usually includes this objective as part of a more general strategy for modifying load shapes that includes increasing consumer demand in off-periods. Implementation of least-cost plans and demand-side programs has made utilities major agents for promoting conservation. Despite numerous studies showing large technical potentials available at low costs, utilities have been ambivalent about this role. This reluctance is due in large part to the influence of conventional regulation, which rewards the utility only for energy sales. Without accommodating changes in regulation, the new role as an energy service provider asks utilities to reduce their markets for the sale of electricity or other energy supplies. In fact, too much conservation could induce an unprofitable excess capacity situation. The effect of a major utility role in developing demand-side resources will be profound. As Kahn surmised, The questions raised by utility conservation programs strike at the core of the principles of public utility regulation. 10 refs., 1 fig., 1 tab.

37115 (CONF-890845–, pp. 511-523) **Evaluating energy-efficiency programs: A personal view of progress and potential.** Hirst, E. (Oak Ridge National Lab., TN (USA)). Argonne National Lab., IL (USA). [1989]. From 4. international energy program evaluation: conservation and resource management; Chicago, IL (USA); 23-25 Aug 1989. In *Energy program evaluation: Conservation and resource management. Proceedings.* Order Number DE90011815. Available from NTIS, PC A21/MF A01.

Evaluation of energy-efficiency programs has come of age. Substantial progress has been made during the past decade in the development and application of improved methods to measure the cost and performance of such programs. These developments include: use of quasi-experimental designs; use of fuel-consumption data to measure energy savings; weather-normalization of fuel-consumption data; consideration of nonresponse bias, self-selection, take-back, and free riders; evaluation of long-term program effects; integration of outcomes and process evaluations; and use of data from a variety of sources and for purposes beyond evaluation. Program evaluators will face new challenges during the 1990s, largely because the role of energy-efficiency programs will expand greatly. These challenges include: integration of evaluation results with forecasts of energy use; conversion of evaluation results into a form useful for program planning; and development of standardized methods to conduct evaluations and to report evaluation results. 43 refs., 2 figs., 4 tabs.

37116 (CONF-900801–13) **Analysis of wallboard containing a phase change material.** Tomlinson, J.J. (Oak Ridge National Lab., TN (USA)); Heberle, D.P. Oak Ridge National Lab., TN (USA). [1990]. 6p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990. Order Number DE90012163. Available from NTIS, PC A02/MF A01 - OSTI.

Phase change materials (PCMs) used on the interior of buildings hold the promise for improved thermal performance by reducing the energy requirements for space conditioning and by improving thermal comfort by reducing temperature swings inside the building. Efforts are underway to develop a gypsum wallboard containing a hydrocarbon PCM. With a phase change temperature in the room temperature range, the PCM wallboard adds substantially to the thermal mass of the building while serving the same architectural function as conventional wallboard. To determine the thermal and economic performance of this PCM wallboard, the Transient Systems Simulation Program (TRNSYS) was modified to accommodate walls that are covered with PCM plasterboard, nd to apportion the direct beam solar radiation to interior surfaces of a building. The modified code was used to simulate the performance of conventional and direct-gain passive solar residential-sized buildings with and without PCM wallboard. Space heating energy savings were determined as a function of PCM wallboard characteristics. Thermal comfort improvements in buildings containing the PCM were qualified in terms of energy savings. The report concludes with a present worth economic analysis of these energy savings and arrives at system costs and economic payback based on current costs of PCMs under study for the wallboard application. 5 refs., 4 figs., 4 tabs.

37117 (CONF-900801–14) **Conventional wallboard with latent heat storage for passive solar applications.** Kedl, R.J. Oak Ridge National Lab., TN (USA). [1990]. 5p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990. Order Number DE90012136. Available from NTIS, PC A02/MF A01 - OSTI.

Conventional wallboard impregnated with octadecane paraffin (Melting Point – 73.5°F) is being developed as a building material with latent heat storage for passive solar applications. Impregnation was accomplished simply by soaking the wallboard in molten paraffin. Concentrations of paraffin in the combined product as high as 35% by weight were achieved. In support of this concept, a computer model was developed to describe thermal transport and storage by a phase change material (PCM) dispersed in a porous media. The computer model was confirmed by comparison with known analytical solutions where the PCM melts at a specific melting point. However, agreement between the model and an experimentally produced thermal transient involving impregnated wallboard was only good after the model was modified to allow the paraffin to melt over a temperature range. This was accomplished by replacing the heat of fusion with a triangular heat capacity relationship that mimics the triangular melt curve found through differential scanning calorimetry. When this change was made, agreement between the model and the experimental transient was very good. 4 refs., 8 figs.

37118 (CONF-900833–2) **Measured space-cooling electricity savings from standard energy conservation measures, radiant barriers, and high-efficiency window air conditioners.** Ternes, M.P.; Levins, W.P. Oak Ridge National Lab., TN (USA). [1990]. 13p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From ACEEE summer study on energy efficiency in buildings; Pacific Grove, CA (USA); 26 Aug - 1 sep 1990. Order Number DE90012769. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A cooperative field test was performed in Tulsa, Oklahoma, to determine the space-cooling electricity consumption of low-income homes equipped with window air conditioners, the reduction in consumption due to energy conservation measures (ECMs) installed under Oklahoma's Weatherization Assistance Program (WAP), and the additional reduction due to two ECMs designed to reduce space-cooling electricity consumption: attic radiant barriers and replacement of low-efficiency window air conditioners with high efficiency units. Eighty-one single-family, owner-occupied houses were divided into a control group and three treatment groups: ECMs performed under Oklahoma's WAP, WAP ECMs plus a

truss-mounted attic radiant barrier, and WAP ECMs plus a high-efficiency window air-conditioner to replace a less efficient unit. Pre-weatherization data were collected during the summer of 1988 and post-weatherization data were collected the following summer. Air-conditioning electricity consumptions and indoor temperatures were monitored weekly. Air-conditioning energy use models and regression analyses were employed to normalize annual space-cooling electricity consumptions and savings to average outdoor temperatures and pre-weatherization indoor temperatures. 5 refs., 4 figs., 1 tab.

37119 (DOE/SF/17538–T6) **Atrium building study.** American Inst. of Architects, Washington, DC (USA). [1990]. 132p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG03-88SF17538. Order Number DE90012502. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The CIGNA design team was faced with creating a new 500,000 square foot office building on a pastoral 610 acre corporate campus in Bloomfield, Connecticut, just outside of Hartford. Challenges abounded during the design process, from the selection of a specific building site on the sprawling campus to the evolution of a building form incorporating an atrium, to the selection of building systems and materials, to the design to the office interiors and atrium landscape. This document summarizes the original design problem, focusing on design criteria and performance standards that led to the decision to design an atrium building as well as decision concerning its function, its form, its building systems and materials, and its passive energy strategies.

37120 (LBL–27440) **Maintaining optimum light output with a thermally conductive heat pipe.** Crawford, D.; Verderber, R.; Siminovitch, M. Lawrence Berkeley Lab., CA (USA). Jun 1989. 5p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. (CONF-8910420–1: 1989 IEEE-IAS annual conference, San Diego, CA (USA), 1-5 Oct 1989). Order Number DE90012423. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper describes some of the current research in the area of lamp wall temperature control for the purpose of enhancing light output under elevated temperatures. More specifically a thermally conductive heat pipe has been employed to maintain optimum lamp wall temperature under varied ambient temperatures. Advantages of a heat pipe over previous methods of enhancing light output include no external power necessary and flexibility in orientation within the fixture. The experiments described include the calibration of heat pipe against a known thermal load, the application of a heat pipe to a lamp in a test chamber and the placement of a heat pipe within a fixture. Theory and experimental data indicate that optimum lamp operating conditions can be maintained throughout an ambient temperature range which typically reduces light output by 20%. 5 refs., 7 figs.

37121 (ORNL/CON–297) **Measurement of energy performance in a small bank building.** Sharp, T.R.; MacDonald, J.M. Oak Ridge National Lab., TN (USA). Apr 1990. 40p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90011294. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report summarizes the measured results from a field study of the performance of a low-cost controls retrofit in a small bank building in Knoxville, Tennessee. The retrofit consisted of an upgrade of heating and cooling system controls and new operating strategies. The study was undertaken to better understand how commercial energy use measurement studies should be performed and to demonstrate the effectiveness of a low-cost controls retrofit in a small commercial building. This report describes the details of the project, including building and building system characteristics, the HVAC control changes implemented, energy end use patterns, and the heating and cooling energy savings achieved. An improved control strategy involving thermostat setback/setup and on/off control was devised around a single replacement programmable thermostat. The strategy allowed thermostat setback/setup control of the primary HVAC system in the building and provided on/off (time-of-day) control for the two secondary systems. The energy efficiency improvements provided a 33% reduction in heating and a 21% reduction in cooling energy consumptions. Simple payback for the retrofit, including installation cost, was less than 1 year. In addition to reducing the energy needs of the building, the replacement electronic thermostat provided improved interior comfort. 10 refs., 12 figs., 6 tabs.

37122 (ORNL/M–1173) **Building Thermal Envelope Systems and Materials (BTESM) and research utilization/technology transfer progress report for DOE Office of Buildings and Community Systems: Monthly progress report.** Oak Ridge National Lab., TN (USA). Apr 1990. 33p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90011289. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The monthly report of the Building Thermal Envelope Systems and Materials (BTESM) Program is a monthly update of both in-house ORNL projects and subcontract activities in the research areas of building materials, wall systems, foundations, roofs, building diagnostics, and research utilization and technology transfer. Presentations are not stand-alone paragraphs every month. Their principal values are the short-time lapse between accomplishment and reporting and their evolution over a period of several months.

37123 (ORNL/TM–11291) **Chlorofluorocarbon (CFC) technologies review of foamed-board insulation for buildings.** McElroy, D.L.; Scofield, M.P. Oak Ridge National Lab., TN (USA). Mar 1990. 66p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90012037. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report reviews the use of foamed-board building insulation and alternative technologies to reduce the use of chlorofluorocarbons (CFCs). CFCs harm the environment by depleting the ozone layer in the stratosphere. Thermal insulations are reviewed to introduce current rigid-foam insulation technology, and alternatives to meet the Montreal Protocol requirements are presented. Analyses of the energy-use impact from alternatives for building envelopes are described. The primary purpose of this report is to provide comments in a matrix table about foam insulations (e.g., rigid polyurethane foam, rigid extruded polystyrene foam, and alternatives) and about primary concerns (e.g., applications, availability, development risks, environmental health and safety, and energy and economic impacts). An appropriate federal role would be to support development and execution of a broad-based research program in cooperation with industry to prove the applicability of new insulation products. The estimated cost to complete an existing research menu of 29 projects in 5 years is $16 million. 42 refs.

37124 (ORNL/TM–11425) **Assessment of the energy conservation potential of active (variable thermal resistance and switchable absorptance) building thermal insulation systems.** Fine, H.A. (Kentucky Univ., Lexington, KY (USA). Dept. of Materials Science and Engineering); McElroy, D.L. Oak Ridge National Lab., TN (USA). Jun 1990. 98p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90012039. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The Electric Power Research Institute (EPRI) Simplified Program for Residential Energy (ESPRE) was used to determine the heating and cooling loads for a hypothetical 1600-ft^2 structure located in three climates (hot, moderate, and cold) and equipped with either passive or active insulation systems. The passive (i.e., time-invariant) insulation systems studied included thermal resistance values for the attic, floor, and walls of 0.5, 19, and 38 h·ft^2·°F/Btu; absorptance values for the roof and walls of 0.1, 0.5, and 0.8; and window transmittance values of 0.1, 0.5, and 0.8. The annual heating-plus-cooling load was calculated for 430 passive systems. The wide variety of passive insulation systems were then optimized using a postsimulation program to establish the minimum load that would result if a set of passive systems could be made active (i.e., switchable from one passive system to another, depending on which passive system produced the lowest heating-plus-cooling load). The annual heating-plus-cooling load was established for 171 active systems. The predicted annual loads with passive insulation systems having an attic thermal resistance of 38 and floor and wall resistances of 19 were Phoenix, Arizona, 58 MBtu; Lexington, Kentucky, 62 MBtu; and Minneapolis, Minnesota, 90 MBtu.

The most energy-conserving systems predicted savings of 20 to 25 MBtu/year in all three climates. Because active fenestration systems yielded nearly half of this potential savings, these systems deserve further study. 19 refs., 7 figs., 25 tabs.

37125 (PIRSEM–8680.N.200) **ARC: Chemical heat pumps.** Spinner, B. Centre National de la Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matiernes Premieres (PRISEM); Perpignan Univ., 66 (France). Sep 1987. 180p. (In French). Order Number DE90501077. Available from NTIS (US Sales Only), PC A09/MF A01.

A review of the research and development ARC program (1984-1987) concerning heat pumps is presented. The main objectives of the program were: thermodynamical and kinetic data comprehensive collection, modelization of the heat and mass transfer couplings with absorption/adsorption/reaction processes, design and development of exchangers and reactors, steady state and transient state process analysis and their control, development and experimentation of significant power prototypes allowing extrapolation to machines with power ranging from hundreds kW to several MW.

37126 (PNL–6109) **Multicomponent case weights for the 1985 resample of the 1983 Pacific Northwest residential energy survey.** Klan, M.S.; Shankle, S.A.; Kellogg, M.A. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 222p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. Order Number DE90012444. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

In this study a set of multicomponent case weights applicable to residential survey information were prepared for the Bonneville Power Administration (BPA) by the Pacific Northwest Laboratory (PNL). These case weights were prepared for the 1985 resample of respondents of an earlier BPA residential energy survey – the original 1983 survey and subsequent surveys administered to the 1985 PNWRES resample were designed to gather information from households concerning their use of energy and related data. The PNWRES samples were drawn based on stratified random sampling techniques, that allow the survey results to represent the characteristics of the overall Pacific Northwest population of residential utility accounts. In order to determine the characteristics of the population, however, the survey results must be appropriately weighted. Case weights were developed for 1983 PNWRES by Lou Harris and Associates, Inc. This report briefly documents PNL's extension of the weighting methodology to the subsequent 1985 PNWRES resample, and describes the resulting caseweights generated by PNL. 9 refs., 5 tabs.

37127 (PNL–6429) **The Residential Building Characteristics On-Site Inspection: Summary report.** Weakley, S.A.; Darwin, R.F.; Howe, T.L. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 56p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. Order Number DE90012434. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Residential Building Characteristics On-Site Inspection (RI) was sponsored by the Bonneville Power Administration (BPA), and implemented by Energy Counselors, Inc., of Beaverton, Oregon. The purpose of the inspection was to collect detailed information on the structural characteristics and capital equipment of residences participating in BPA's End-Use Load and Conservation Assessment Program (ELCAP). ELCAP is a long-term program to collect information on the structural characteristics of residences in the Pacific Northwest as well as the attitudinal, behavioral, and demographic characteristics of the residences' occupants. Combined with other data collection efforts, the information obtained by the RI will be used to assess and evaluate energy use and conservation within the region's residential sector. This report documents the design of the inspection instruments (forms), the implementation of the inspection, and some of the results from the data base. The number of residences inspected was 416 or 93% of the potential sample of 447 residences. 1 ref., 2 figs., 38 tabs.

37128 (PNL–6441) **Analysis of air-to-air heat exchanger performance data taken under the Residential Standards Demonstration Program.** Drost, M.K. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 73p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. Order Number DE90012435. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Bonneville Power Administration (BPA) initiated the Residential Standards Demonstration Program (RSDP) in 1983 to determine the costs and thermal performance improvements associated with increased levels of thermal integrity in new residences, as proposed by the Northwest Power Planning Council in the Model Conservation Standards (MCS). The program resulted in the construction of approximately 430 new residences, built to thermal performance standards, as dictated by the MCS in each of three climate zones in the region. A subset of the residences has been included in the End-Use Load and Consumer Assessment Program (ELCAP) being conducted by the Pacific Northwest Laboratory (PNL) for the Bonneville Power Administration (BPA). These structures are metered to record hourly energy consumption for several end-uses. Many of the structures built to the MCS include air-to-air heat exchangers (AAHXs) to provide ventilation for maintenance of indoor air quality and comfort. Of the 71 MCS structures included in the ELCAP sample, 38 included air-to-air heat exchangers and had sufficient data to allow an analysis of both use patterns and thermal performance. This report describes the results of the analysis of the AAHX installations using the data collected as part of ELCAP.

37129 (SWEG-R–41) **An approach to the design of energy efficient heated buildings.** Crabb, J.A. Exeter Univ. (UK). Energy Study Unit. Sep 1988. vp. Available from British Library, Document Supply Centre, Boston Spa, Wetherby, West Yorks.

This booklet is about designing energy efficient buildings which are able to provide an appropriate internal environment whilst consuming a minimum amount of energy. A certain level of energy efficiency is ensured by the building regulations and it is assumed that these minimum insulation requirements will be met in any new building. There is, however, plenty of further scope for improving the performance of buildings. This does not usually entail the addition of more wall and ceiling insulation, but instead requires an appreciation of some of the underlying factors which affect energy performance. In essence, the architect can either create a building which is in tune with its environment and the requirements of its occupants or at odds with them. This book is aimed at achieving the former and avoiding the latter. There are two things which it specifically does not do. The first has already been touched on. It is not usually cost effective to add fabric insulation above building regulation standards if this is the only measure adopted. Emphasis is therefore placed on higher priority measures and further insulation is not discussed except where it is required to effect a specific improvement in system performance. (author).

37130 **Selection of ozone-safe, nonazeotropic refrigerant mixtures for capacity modulation in residential heat pumps.** Vineyard, E.A. (Oak Ridge National Lab., TN (USA)); Sand, J.R.; Statt, T.G. pp. 34-46 of ASHRAE 1989 winter meeting. (Technical Papers). American Society of Heating Refrigeration and Air Cond., Atlanta, GA (USA) (1988). DOE Contract AC05-84OR21400. (CONF-890105–: ASHRAE winter meeting, Chicago, IL (USA), 28 Jan - 1 feb 1989).

Many combinations of refrigerants have been tested in an effort to improve the efficiency of residential heat pumps. Up to this point, there has been no systematic approach for determining which fluid pairs have the greatest potential for improving heat pump performance. This paper reports on work to perform a comprehensive screening of refrigerant pairs which, through a shift in composition, could improve the performance of heat pump systems by modulating their capacity to better follow a building load.

37131 **Enactment of federal energy efficiency standards for residential appliances.** McMahon, J.E. (Lawrence Berkeley Lab., Berkeley, CA (US)). pp. 35-42 of Energy economics and energy politics. International Assoc. of Energy Economists, Washington, DC (USA) (1987). DOE Contract AC03-76SF00098. (CONF-871122–: 9. annual North American meeting of the International Association of Energy Economists on energy economics and energy politics, Washington, DC (USA), 11-13 Nov 1987).

The sudden increase in oil prices in 1973, and again in 1979, focussed the attention of many people on energy. This paper contains a description of the major events in the establishment of federal minimum efficiency standards for residential appliances. The residential sector consumed 35% of the electricity and 28% of the natural gas in the U.S. in 1986. Legislation requiring mandatory efficiency standards was passed in 1978, 5 years after the 1973 oil crisis. More than another 8 years were to pass before the amount of improvement required by the efficiency standards was to be specified. For most products, 3 to 5 years are allowed after that specification before implementation on a national basis. Institutional and political barriers, more than technical or analytical problems, seemed to determine the time course of events. This paper addresses the process of adoption of federal residential appliance efficiency standards from 1979 to 1987.

37132 **How to evaluate a building from short-term tests.** Subbarao, K. (Solar Energy Research Inst., Golden, CO (USA)); Burch, J.; Hancock, C.E.; Lekov, A.; Balcomb, J.D. pp. 256 of Proceedings of the 9th Miami international congress on energy and environment. Volume 1-2 (Abstracts). Veziroglu, T.N. Univ. of Miami, College of Engineering, Coral Gables, FL (USA) (1989). (CONF-891210--: 9. Miami international congress on energy and environment, Miami Beach, FL (USA), 11-13 Dec 1989).

In order to establish the energy effectiveness of various design strategies and new building products, it is essential to test actual buildings. Tests indicate that the best model derived from a site visit gives significantly different performance from the actual one. Only short-term tests are practical if tests are to be cost-effective and suitable for widespread use. SERI has developed a method for short-term tests, data analysis and extrapolation to long-term as well as peak load performance. This method properly accounts for the complexities of actual buildings, occupancy patterns, and local weather conditions. The technique, based on a calibrated energy balance equation is called PSTAR (primary and secondary terms analysis and renormalization). The PSTAR formulation resolves the conflicting requirements of a realistically complex model of the building with a manageably small number of parameters to be obtained by fitting to short-term performance data. Starting with hourly data on a small number (about 20) channels taken over a two to three day period, the method determines renormalization factors to reconcile measured performance with a mathematical model of the building based on a quick audit description. The resulting renormalized energy balance equation allows an hourly simulation of the as-built building and is used in applications - in particular in extrapolating to long-term performance.

37133 **Evaluation of advanced glazing technologies.** Selkowitz, S. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA (US)). pp. 241-260 of Building design and human performance. Ruck, N.C. Van Nostrand Reinhold Co., Inc., New York, NY (USA) (1989).

The building envelope has been dictated by the resources and technological options available and by the functions of the building. For example, the medieval fortress was a logical design within its historical context. A glasswalled automobile showroom is an equally appropriate design in a different context. Today, glass plays a significant role in the design of almost all building envelopes. Since its emergence during the last century as a major building material, it has evolved into a versatile design element performing functions today that would have been unthought of only a few years ago. Windows and other glazed openings can solve complex needs that require variable properties and tradeoffs between conflicting conditions. For example, the glazing that provides a view must also provide visual privacy, and glazing that admits daylight and hence reduces electric lighting needs also can create discomfort and disability glare. The sun that provides desirable warmth in the winter also contributes to thermal discomfort and cooling requirements in the summer.

37134 **U-values, solar heat gain and thermal performance: Recent studies using the MoWiTT.** Klems, J.H. (Lawrence Berkeley Lab., CA (USA). Applied Science Div.). pp. 609-620 of ASHRAE 1989 winter meeting. (Technical Papers). American Society of Heating Refrigeration and Air Cond., Atlanta, GA (USA) (1989). DOE Contract AC03-76SF00098. (CONF-890105--: ASHRAE winter meeting, Chicago, IL (USA), 28 Jan - 1 feb 1989).

U-value measurements made with the MoWiTT field test facility and at a commercial laboratory for four commercial windows are compared with calculations made with the Window program. Good agreement is found for three of the windows; for the fourth - a double-glazed window with a highly conductive frame - agreement is good between the calculations and the MoWiTT measurements, but agreement with the test laboratory is only marginal. Measurements of overall diurnal performance are presented, and it is shown that, even for a north-facing window, the uncertainties in thermal performance due to solar gain effects overshadow the effects of improved U-value. The author argues the need for better methods of accounting for solar gain effects in window performance comparisons, so that the net benefits of U-value improvements may be correctly assessed.

37135 **A steam dispatching control system for Fort Benjamin Harrison, Indiana.** McLain, H.A. (Oak Ridge National Lab., TN (USA)); Karnitz, M.A.; Shonder, J.A. pp. 812-822 of ASHRAE 1989 winter meeting. (Technical Papers). American Society of Heating Refrigeration and Air Cond., Atlanta, GA (USA) (1989). (CONF-890105--: ASHRAE winter meeting, Chicago, IL (USA), 28 Jan - 1 feb 1989).

A steam dispatching control system (SDCS) is a system for improving the thermal efficiency of steam distribution networks. The SDCS regulates the steam pressures in the network just enough to satisfy the steam requirements of the connected buildings. This minimizes the distribution network thermal losses. The steam distribution network at Fort Benjamin Harrison, IN, has been selected for future SDCS field demonstration. Numerical analysis of the system, using a distribution network thermal efficiency computer model, indicates that the SDCS is a viable option for this site. About 12 TJ (11 by 10^9) Btu of steam energy would be saved each year, which is about 3.4% of present annual steam energy. The coal savings associated with this translates to an estimated simple payback time of 4.2 years. Had natural gas been used as the fuel, this value would be about 1.3 years.

37136 **Analysis of three measures for energy efficiency of residential gas furnaces.** Kweller, E.R. (Department of Energy, Washington, DC (USA). Office of Buildings and Community Systems). pp. 930-938 of ASHRAE 1989 winter meeting. (Technical Papers). American Society of Heating Refrigeration and Air Cond., Atlanta, GA (USA) (1989). (CONF-890105--: ASHRAE winter meeting, Chicago, IL (USA), 28 Jan - 1 feb 1989).

The effectiveness of three measures of energy efficiency for furnaces has been demonstrated by comparison of the results for predicted energy savings against the cost savings predicted by the calculated total annual cost of operation using Department of Energy (DOE) test procedures. Two of the efficiency measures currently prescribed by the DOE - the annual fuel utilization efficiency (AFUE) and the DOE energy factor (EF) are compared with an industry-proposed energy factor the seasonal energy utilization factor (SEUF). Various parameters that affect the SEUF have also been demonstrated. These include the effects of power rating (wattage), burner input rating, electric to fossil fuel cost ratio, and the effect of annual fuel utilization efficiency (AFUE).

37137 **Impact of heating and air conditioning system operation and leakage on ventilation and intercompartment transport: Studies in unoccupied and occupied Tennessee Valley homes.** Matthews, T.G. (Oak Ridge National Lab., TN (USA)); Wilson, D.L.; Thompson, C.V.; Monar, K.P.; Dudney, C.S. *Journal of the Air and Waste Management Association (USA)*, 40(2): 194-198 (Feb 1990).

Forced-air heating and air conditioning (HAC) systems caused an average and maximum increase in air infiltration rates of 1.8- and 4.3-fold, respectively, during brief whole-house studies of tracer gas decay in 39 occupied houses. An average increase in air infiltration rate of 0.33 +/- 0.37 h-1 corresponded to an incremental air leak of 240 m3/h, based on approximate house volume. More detailed tracer gas decay studies were performed in basement, kitchen and bedroom locations of six homes with low air infiltration rates (i.e., less than 0.25 h-1). The HAC mixed the indoor air efficiently between measurement sites. HAC operation also

caused 1.1- to 3.6-fold increases in air infiltration rates, corresponding to absolute increases of 0.02 to 0.1 h-1. In an unoccupied research house, three-fold increases in average air infiltration rate with HAC operation (i.e., from 0.13 to 0.36 h-1) were reduced to two-fold (i.e., from 0.10 to 0.18 h-1) by sealing the external HAC unit and crawlspace ductwork system. This sealing also resulted in a 30 percent reduction in crawlspace-to-indoor transport rates with the HAC turned on. Blower door tests indicated a less than 20 percent reduction in house leakage area.

3202 Transportation

Refer also to citation(s) 37155, 37156, 37159

37138 (CONF-8710452--) **1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion: Proceedings.** Kare, J.T. (ed.). Lawrence Livermore National Lab., CA (USA). 1 Mar 1990. 252p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. From 1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA); 14-18 Oct 1987. Order Number DE90013484. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

Two dimensional effects on laser propulsion performance were studied analytically using an ideal gas model. The two processes considered for an axially symmetric detonation wave are the effect of radial expansion within the detonation reaction layer and the effect of radial expansion in the region between the detonation wave and the base plate. In both cases, the two dimensional effects cause the reduction of the base pressure and the total thrust. The amount of reductions of base pressures are calculated and are plotted as functions of the reaction length/beam radius and beam radius/detonation were travel distance, respectively. Each report will be individual cataloged.

37139 (ORNL--6626) **Light-duty vehicle MPG [miles per gallon] and market shares report, Model year 1989.** Williams, L.S. (Tennessee Univ., Knoxville, TN (USA)); Hu, P.S. Oak Ridge National Lab., TN (USA). Apr 1990. 276p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90012006. Available from NTIS, PC A13/MF A01 - OSTI; GPO Dep.

This issue of Light-Duty Vehicle MPG and Market Shares Report: Model Year 1989 reports the estimated sales-weighted fuel economies, sales, market shares, and other vehicle characteristics of automobiles and light trucks. The estimates are made on a make and model basis (e.g., Chevrolet is a make and Corsica is a model), from model year 1976 to model year 1989. Vehicle sales data are used as weighting factors in the sales-weighted estimation procedure. Thus, the estimates represent averages of the overall new vehicle fleet, reflecting the composition of the fleet. Highlights are provided on the trends in the vehicle characteristics from one model year to the next. Analyses are also made on fuel economy changes to determine what caused the changes. Both new automobile and new light truck fleets experienced fuel economy losses of 0.5 mpg from the previous model year, dropping to 28.0 mpg for automobiles and 20.2 mpg for light trucks. This is the first observed decline in fuel economy of new automobiles since model year 1983 and the largest decline since model year 1976. The main reason for the fuel economy decline in automobiles was that every automobile size class showed either losses or no change in their fuel economies. The fuel economy decline in light trucks was primarily due to the fact that two popular size classes, large pickup and small utility vehicle, both experienced losses in their fuel economies. Overall, the sales-weighted fuel economy of the entire light-duty vehicle fleet (automobiles and light trucks) dropped to 25.0 mpg, a reduction of 0.5 mpg from model year 1988. 9 refs., 32 figs., 50 tabs.

37140 (ORNL/M--1188) **Feasibility of exclusive facilities for cars and trucks: Final report.** Janson, B.N. (Oak Ridge National Lab., TN (USA)); Rathi, Anju. Oak Ridge National Lab., TN (USA). Apr 1990. 106p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Contract DTFH61-89-Y-00018. Order Number DE90012976. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report describes an analysis format to determine the economic feasibility of separating light vehicles from heavy vehicles on a given section of controlled-access highway by designating existing lanes and/or constructing new lanes to be used exclusively by light or heavy vehicles. Based on user inputs describing characteristics of a highway, a computer program calculates the net present values and benefit/cost ratios of alternative exclusive vehicle facility designs. The analysis program can be run in either of two modes called Level 1 and Level 2. Level 1 provides a sketch evaluation of many alternatives for a given highway section with few user inputs, and Level 2 is used to conduct more thorough evaluations of particular alternatives. Based on test analyses, exclusive vehicle facilities appear to be most warranted for congested highways where truck volumes exceed 30% of the vehicle mix. Assuming moderate traffic growth over an analysis period of at least 20 years, adding exclusive lanes for light vehicles via highway widening can have a greater net present value than designating existing lanes for light vehicles or adding mixed-vehicle lanes. However, designating one or two existing lanes of a highway with three or more lanes in each direction exclusively for light vehicles can be a very beneficial low-cost strategy. The analysis format is intended for site specific analyses and not for regional or national network analyses. The scope of the study did not include developing nationwide estimates of exclusive vehicle facility lane miles that might be justified in the decades ahead. 48 refs., 2 figs., 24 tabs.

3203 Industrial and Agricultural Processes

Refer also to citation(s) 37400

37141 (AFME-FR--10) **Ten years of pilot technical applications of energy conservation in the industry.** Agence Francaise pour la Maitrise de l'Energie, 75 - Paris (France). 1987. 36p. (In French). Order Number DE90501022. Available from NTIS (US Sales Only), PC A03/MF A01.

A review of the various pilot operations conducted by the French Agency for Energy Conservation (AFME) in the energy conservation domain among various industrial sectors is presented. For each company the operation is rapidly described; the different sectors are: iron and steel industry, automobile and mechanics industry, building materials, glass, chemistry, energy production, papers, food industry, drying, textile industry, wood industry, etc.

37142 (CONF-900801--6) **Recycling of plastics in automobile shredder residue.** Jody, B.J.; Daniels, E.J.; Bonsignore, P.V.; Dudek, F.J. Argonne National Lab., IL (USA). 12 Apr 1990. 6p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract W-31109-ENG-38. From 25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990. Order Number DE90011110. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Argonne National Laboratory has been conducting experiments to recover some of the plastics in the auto shredder residue (ASR) for recycling into the plastics manufacturing stream. As part of the study, we also reviewed the literature related to the disposal and handling of ASR. The results indicate that using solvents to extract individual thermoplastics or mixtures from ASR is technically feasible. The economic competitiveness of the process depends on many factors, including the cost of disposal, how the individual plastics affect the disposal method and cost, and the market value of the recovered plastics. We present the results obtained so far and the integrated treatment and disposal procedures that are compatible with the needs of industry. 4 refs., 2 figs.

37143 (CONF-900801--12) **A magnetically coupled Stirling engine driven heat pump: Design optimization and operating cost analysis.** Vincent, R.J.; Waldron, W.D. Mechanical Technology, Inc., Latham, NY (USA). [1990]. 23p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990. Order Number DE90011242. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A preliminary design for a 2nd generation, gas-fired free-piston Stirling engine driven heat pump has been developed which incorporates a linear magnetic coupling to drive the refrigerant compressor piston. The Mark 2 machine is intended for the residential heat pump market and has 3 Ton cooling capacity. The new heat pump is an evolutionary design based on the Mark 1 free-piston machine which was successfully developed and independently tested by a major heat pump/air conditioning manufacturer. This paper briefly describes test results that were obtained with the Mark 1 machine and then presents the design and operating cost analysis for the Mark 2 heat pump. Operating costs by month are given for both Chicago and Atlanta. A summary of the manufacturing cost estimates obtained from Pioneer Engineering and Manufacturing Company (PEM) are also given. 9 figs., 3 tabs.

37144 (CONF-8809312–2) **Comparison of ethanol recovery processes from an immobilized cell reactor-separator.** Dale, M.C.; Koo, Y.M.; Havlik, S.; Okos, M.R. Purdue Univ., Lafayette, IN (USA). Dept. of Agricultural Engineering. [1988]. 35p. Spcnsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG02-85CE40772. From AIChE summer national conference; Denver, CO (USA); 21-24 Sep 1988. Order Number DE90012421. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A novel reactor-separator for the production of ethanol using immobilized cells has shown high reaction rates. This immobilized cell reactor separator (ICRS) is characterized by a recycled stripping carbon dioxide gas stream passing through an immobilized cell bed. The ethanol product leaves the ICRS as a vapor in a gas stream. In this paper four basic recovery systems to obtain an concentrated ethanol product from this gas stream are compared on a present value economic basis. The effects of (1) inlet vapor ethanol concentration, (2) process scale, and (3) energy recovery techniques on the capital and energy requirements of the separation system are analyzed with sales of ethanol product at an assumed value $1.00/gal balanced against separation costs. The four methods considered consist of: absorption of the ethanol from the fermenter gas into a countercurrent water stream followed by distillation of the ethanol water; partial condensation of the vapors followed by distillation of the condensate, while the cool gas goes to an absorber to absorb the non-condensed product; rectification of the ethanol in the gas stream followed by condensation and feed absorption of the non-condensed product; and absorption of the ethanol onto a solid adsorbant bed followed by desorption using hot gas. 18 refs., 12 figs., 9 tabs.

37145 (CONF-9008117–1) **Hardware development and initial subassembly test of a gas-fired Stirling/Rankine residential heat pump.** Chen, G. (Sunpower, Inc., Athens, OH (USA)); McEntee, J. Oak Ridge National Lab., TN (USA). [1990]. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From IECEC conference; Reno, NV (USA); 7-8 Aug 1990. Order Number DE90012203. Available from NTIS, PC A02/MF A01 - OSTI.

A gas-fired Stirling/Rankine heat pump is being developed at Sunpower, Inc. The free-piston Stirling engine/magnetic coupling/refrigerant compressor (FPSE/MC/C) assembly used as the power module for this type of heat pump is currently in the assembly and test phase. To achieve high efficiency, low cost, and a more durable system, modifications have been made to a previously introduced design. The modifications include changes in material selection, a different displacer drive, and the use of low-cost and more efficient cooler design. A commercially available R-22 compressor is used in the prototype. Low cost iron-neodymium permanent magnets are used to provide an efficient magnetic coupling design. To match the engine power to the load, a double-acting variable has spring is arranged in parallel with the engine and compressor. After the gas spring was designed and fabricated, it was tested with the compressor. Before system integration and test, the engine/alternator and the compressor/heat pump have been set up and are to be tested separately. 5 refs., 9 figs., 2 tabs.

37146 (DOE/CE/40626–T5) **Research on droplet formation for application to kraft black liquors—Final project report: Technical report No. 5.** Bousfield, D.W. Maine Univ., Orono, ME (USA). Jan 1990. 280p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CE40626. Order Number DE90011131. Available from NTIS, PC A13/MF A01 - OSTI; GPO Dep.

The objective of this project was to generate technical data to guide the design of new nozzles for kraft black liquor recovery boilers. The goal of new nozzle designs would be to narrow the droplet size distribution compared to current nozzles and to adjust for changing black liquor properties and production requirements. Uniform droplets in a recovery boiler should reduce fouling of superheater tubes and caused a more efficient burning of the black liquor, both of which result in improved energy efficiency. The research was organized into five tasks which are described in the next chapter. This fifth and final project report contains the details of Task 4 and 5 and further analysis of Task 1 results. The details of the other tasks are reported in previous technical reports. The major results from the entire project are highlighted in this section in order of significance.

37147 (DOE/ER/30133–H1-Vol.1) **Membrane separation systems—A research and development needs assessment: Executive summary: Volume 1.** Baker, R.W. (Membrane Technology and Research, Inc., Menlo Park, CA (USA)); Cussler, E.L.; Eykamp, W.; Koros, W.J.; Riley, R.L.; Strathmann, H. USDOE Office of Energy Research, Washington, DC (USA). Office of Program Analysis; USDOE Membrane Separation Systems Research Needs Assessment Group (USA). Mar 1990. 111p. Sponsored by U.S. DOE Energy Research. DOE Contract AC01-88ER30133. Order Number DE90011771. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Membrane based separation technology, a relative newcomer on the separations scene, has demonstrated the potential of saving enormous amounts of energy in the processing industries if substituted for conventional separation systems. Over 1 quad annually, out of 2.6, can possibly be saved in liquid-to-gas separations, alone, if membrane separation systems gain wider acceptance, according to a recent DOE/OIP (DOE/NBM-80027730 (1986)) study. In recent years great strides have been made in the field and offer even greater energy savings in the future when substituted for other conventional separation techniques such as distillation, evaporation, filtration, sedimentation, and absorption. An assessment was conducted by a group of six internationally known membrane separations experts who examined the worldwide status of research in the seven major membrane areas. This encompassed four mature technology areas: reverse osmosis, micorfiltration, ultrafiltration, and electrodialysis; two developing areas: gas separation and and pervaporation; and one emerging technology: facilitated transport. Particular attention was paid to identifying the innovative processes currently emerging, and even further improvements which could gain wider acceptance for the more mature membrane technology. The topics that were pointed out as having the greatest research emphasis are pervaporation for organic-organic separations; gas separation; micorfiltration; an oxidant-resistant reverse osmosis membrane; and a fouling-resistant ultrafiltration membrane. 35 refs., 6 figs., 22 tabs.

37148 (DOE/ER/30133–H1-Vol.2) **Membrane separation systems—A research and development needs assessment: Final report: Volume 2.** Baker, R.W. (Membrane Technology and Research, Inc., Menlo Park, CA (USA)); Cussler, E.L.; Eykamp, W.; Koros, W.J.; Riley, R.L.; Strathmann, H. USDOE Office of Energy Research, Washington, DC (USA). Office of Program Analysis; USDOE Membrane Separation Systems Research Needs Assessment Group (USA). Apr 1990. 368p. Sponsored by U.S. DOE Energy Research. DOE Contract AC01-88ER30133. Order Number DE90011770. Available from NTIS, PC A16/MF A01 - OSTI; GPO Dep.

Industrial separation processes consume a significant portion of the energy used in the United States. A 1986 survey by the Office of Industrial Programs estimated that about 4.2 quads of energy are expended annually on distillation, drying and evaporation operations. This survey also concluded that over 0.8 quads of energy could be saved in the chemical, petroleum and food industries alone if these industries adopted membrane separation systems more widely. Membrane separation systems offer significant advantages over existing separation processes. In addition to consuming

less energy than conventional processes, membrane systems are compact and modular, enabling easy retrofit to existing industrial processes. The present study was commissioned by the Department of Energy, Office of Program Analysis, to identify and prioritize membrane research needs in light of DOE's mission. Each report will be individually cataloged.

37149 (DOE/PE/77026–T1) **The effects of land disposal restrictions for certain hazardous-waste contaminated soil and debris on energy-related industries: Final report.** Energetics, Inc., Columbia, MD (USA). 23 Sep 1988. 205p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC01-85PE77026. Order Number DE90012430. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

This report examines and characterizes the impacts of land disposal restrictions on US energy industries. It reviews and analyzes major federal legislation affecting land disposal, traces the history of regulatory implementation of that legislation, and characterizes the issues raised during recent promulgation of disposal restriction rules. It also outlines a series of strategic regulatory considerations that reflects the EPA's (Environmental Protection Agency) future directions in this area. 106 refs., 8 figs., 17 tabs.

37150 (EGG-M–90130) **Membrane process designs in the recovery of bio-fuels and bio-chemicals.** Leeper, S.A. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 3p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-76ID01570. (CONF-900892–3: ICOM '90: international congress on membranes and membrane processes, Chicago, IL (USA), 20-24 Aug 1990). Order Number DE90010933. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In this presentation, the emerging membrane unit operations and process designs that can be used in recovery of fuels and organic chemicals produced via bioconversion are briefly summarized. Product recovery costs are a major barrier to increased use of bioconversion for the production of fuels and chemicals. The integration of developing membrane unit operations into product recovery schemes may reduce process energy requirements and cost. Membrane unit operations that are used or studied in recovery of bio-fuels and organic chemicals include pervaporation (PV), vapor permeation (VPe), reverse osmosis (RO), membrane extraction, and electrodialysis (ED). Although it can be argued that ultrafiltration (UF) is used to purify bio-fuels and bio-chemicals, UF is not included in this survey for two reasons: (1) the primary uses of UF in bioprocessing are to clarify fermentation broth and to retain cells/enzymes in bioreactors and (2) the literature on UF in biotechnology is expansive. Products of bioconversion for which data are compiled include ethanol, acetone, butanol, glycerol, isopropanol, ethyl acetate, fusel oils, acetaldehyde, acetic acid, butyric acid, citric acid, propionic acid, succinic acid, and tartaric acid. 13 refs.

37151 (EGG-M–90133) **Membrane technology applications in the food industry: Present and future.** Leeper, S.A.; Mohr, C.M.; Engelgau, D.E.; Charboneau, B.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 3p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-76ID01570. (CONF-900892–2: ICOM '90: international congress on membranes and membrane processes, Chicago, IL (USA), 20-24 Aug 1990). Order Number DE90010939. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This presentation provides an overview of present, near-term, and potential applications of membrane technology in the food industry. This presentation is based on a comprehensive survey of membrane applications and research in the food industry prepared by EG&G Idaho, Inc. for the US Department of Energy, Office of Industrial Programs. 2 refs., 3 tabs.

37152 (IRD–54-62) **The development of an expert system for heat exchanger selection.** Halliday, G. (NEI International Research and Development Co. Ltd., Newcastle-on-Tyne (UK)); Heppenstall, T. Department of Energy, London (UK). Energy Efficiency Office; NEI International Research and Development Co. Ltd., Newcastle-on-Tyne (UK). Feb 1990. 89p. Order Number DE90799623. Available from NTIS (US Sales Only), PC A05/MF A01.

This project considers the use of expert systems in selecting heat exchangers for heat recovery applications. A prototype system has been designed and built. The overall content of the model is as intended and demonstrations of the selection system to experts in the field have produced favourable comment. However, the necessary effort to develop a commercially acceptable package was far greater than had been originally anticipated - partly because there is no established testing procedure for expert systems and partly because no single expert felt confident to criticise the whole range of expertise within the model. Thus, the selection system remains a prototype but the development effort has clearly shown the value of such a system and given useful experience of the problems in developing expert systems. (author).

37153 (PB–90-865528/XAB) **Tribology: Coatings. October 1976-March 1990 (A Bibliography from the COMPENDEX data base). Report for October 1976-March 1990.** National Technical Information Service, Springfield, VA (USA). Apr 1990. 125p. Available from NTISPC N01/MF N01.

Supersedes PB–89-858617.

This bibliography contains citations concerning design, evaluation, selection, characterization and failure analysis of tribological coatings. Tribological materials and comparative analyses for coatings are included. Surface studies, methods of application, and effects of the methods of application on the tribological properties of the coatings are also discussed. (This updated bibliography contains 271 citations, 30 of which are new entries to the previous edition.)

3206 Municipalities and Community Systems

Refer also to citation(s) 37048, 37049, 37050, 37051, 37052, 37053, 37054, 37055, 37056, 37057, 37058, 37059, 37060, 37061, 37062, 37063, 37064, 37065, 37066, 37067, 37068, 37069, 37070, 37071, 37072, 37073, 37074, 37075, 37076, 37077, 37078, 37079, 37080, 37081, 37082, 37083, 37084, 37085, 37086, 37087, 37088, 37089, 37090, 37091, 37092, 37093, 37094, 37095, 37096, 37097, 37098, 37099, 37100, 37101, 37102, 37103, 37104, 37105, 37106, 37107, 37108, 37109, 37110, 37111, 37112, 37113, 37114, 37115

3209 Education and Public Relations

37154 (DOE/OR/21400–T257) **Training scientists and engineers for the year 2000: Testimony before the Subcommittee on Science, Technology, and Space , Committee on Commerce, Science, and Transportation, United States Senate.** Trivelpiece, A.W. Oak Ridge National Lab., TN (USA). [1990]. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012690. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper is a transcript of testimony by Alvin W. Trivelpiece, director of ORNL, before Congressional Subcommittee on Science, Technology, and Space. Dr. Trivelpiece discusses the importance of training scientist and engineers for the year 2000. (FSD)

33 ADVANCED PROPULSION SYSTEMS

37155 (CONF-900801–7) **Three-dimensional parametric study for MHD marine propulsion.** Doss, E.D. (Argonne National Lab., IL (USA)); Roy, G.D. Argonne National Lab., IL (USA). [1990]. 7p. Sponsored by U.S. Department of Defense. DOE Contract W-31109-ENG-38. Contract N00014-89-F-0064. From 25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990. Order Number DE90011100. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The performance of MHD seawater thrusters have been investigated using a three-dimensional MHD flow model. The model incorporates the interaction between the flow fields and the electrical fields inside the thruster. A parametric study has been performed using the three-dimensional MHD flow model to analyze the performance of continuous electrode seawater thrusters under different operating parameters. The effects of these parameters on the fluid flow characteristics, and on the thruster efficiency have

been investigated. Those parameters include the magnetic field (10–20 T), thruster diameter (1–2 m), surface roughness (0–2 mm), flow velocity (5–30 m/s), and the electric load factor (1–10). The results of the three-dimensional computations indicate that the velocity profiles are flatter over the sidewalls in comparison to the velocity profiles over the electrode walls. However such differences are not significant. The results of the parametric study show that the thruster electrical efficiency increases with the strength of the magnetic field and thruster diameter, and decreases with the flow velocity and surface roughness. 8 refs, 8 figs., 1 tab.

3301 Internal Combustion Engines

Refer also to citation(s) 36714, 36742, 36753, 37139, 37230, 37371

37156 (ANL/ESD–5) **Outlook for ceramics in heat engines, 1990–2010: A technical and economic assessment based on a worldwide Delphi survey.** Larsen, R.P.; Vyas, A.D.; Teotia, A.P.S.; Johnson, L.R. Argonne National Lab., IL (USA). Energy Systems Div. Feb 1990. 141p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract W-31109-ENG-38. Order Number DE90011262. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The role of advanced ceramic materials in heat engines used in transportation applications was assessed from technical and economic perspectives. Key results are presented from a 1986 worldwide Delphi survey on the expected timing and rate of market development for ceramic engine components and ceramic-intensive engines. Also presented are the benefits of and barriers to the use of ceramic technology in heat engines and factors influencing its rate of adoption. The survey projects that by the mid-1990s, a substantial number of ceramic engine components will be in production and ceramic-intensive engines will be introduced. From the survey data, a computer model produced market penetration curves for individual ceramic engine components in both light- and heavy-duty applications. The model results were combined with price projections to estimate microeconomic effects by component. When aggregated, these projections of economic activity were used as inputs to a macroeconomic model of the US economy, which projected overall economic effects under different scenarios of ceramic technology development. The level of international competition in developing this technology is presented, with implications for economic and technical leadership in this field. Finally, the conditions required for the rapid development of heat engine markets for ceramic technology are discussed. 11 refs., 45 figs., 26 tabs.

3302 External Combustion Engines

Refer also to citation(s) 36847, 37156

3303 Electric-Powered Systems

37157 (DOE/ID–10262) **Engineering evaluation testing of the Soleq Dual Battery Van.** MacDowall, R.D.; Burke, A.F. EG and G Idaho, Inc., Idaho Falls, ID (USA). Jun 1990. 115p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-76ID01570. Order Number DE90012685. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report presents the results of engineering evaluation testing of the Soleq Dual Battery Van, which is full-size Dodge van retrofitted with a DC electric powertrain developed by Soleq Corporation of Chicago, Illinois. The purpose of the INEL testing was to quantify the performance and energy utilization of the Dual Battery Van, as outlined in the Society of Automotive Engineers (SAE J227) Electric Vehicle Test Procedure, and to provide a comparison with other electric vehicles of similar size and weight under equivalent conditions. 14 refs., 35 figs., 19 tabs.

3306 Vehicle Design Factors

Refer also to citation(s) 37229

3307 Emission Control

Refer also to citation(s) 37371

37158 (UBA-FB–89-150) **Emission and biological activity of N-containing polycyclic aromatic compound as exhaust of Diesel engines.** Lorber, K.E.; Mollenhauer, K. Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technischen Umweltschutz; Technische Univ. Berlin (Germany, F.R.). Inst. fuer Konstruktionslehre und Thermische Maschinen; Umweltbundesamt, Berlin (Germany, F.R.). Apr 1988. 297p. (In German). Contract UFOPLAN-Nr. 10405544. Available from Copy held by UB/TIB Hannover.

Investigating three different types of Diesel motors, combustion generated PAH and NO_2-PAH particulate emissions have been studied under stationary engine conditions. For the determination of about 25 compounds, a reliable trace analysis procedure was developed, using GC as well as HPLC techniques after chromatographic clean up. Results achieved are indicating some correlations between operating-parameters and quality as well as quantity of PAH and NO_2-PAH emitted. At low fuel to air ratios (idling conditions), the NO_2-PAH concentrations of the relative low particle emission seem to be significantly increased, whereas with increasing fuel to air ratios (maximum load condition) the particle emission itself becomes maximum. Consequently, for all motors investigated, the particulate NO_2-PAH-emissions were found to be increased at low as well as at high fuel to air ratios and decreased under normal operating conditions at medium load. (orig.) With 60 refs., 19 tabs., 204 figs.

3308 Alternative Fuels

Refer also to citation(s) 36824, 37032

37159 (ORNL/TM–11448) **Alternative Motor Fuel Use Model: Model theory and design and user's guide.** Greene, D.L. (Oak Ridge National Lab., TN (USA)); Rathi, A. Oak Ridge National Lab., TN (USA). Mar 1990. 156p. Sponsored by U.S. DOE Office of Policy, Planning and Analysis. DOE Contract AC05-84OR21400. Order Number DE90012040. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

The Alternative Motor Fuel Use Model (AMFU) is a tool for the analysis and prediction of motor fuel use by highway vehicles. The model advances the art of vehicle stock modeling by including a representation of the choice of motor fuel for flexible and dual fuel vehicles. Part one of the report is a User's Guide to the operation of the model. Part two describes the model's structure and the theory of vehicle stock modeling of energy use on which it is based. The model is designed for IBM PC, PC/XT, PC/AT, PS/2, and compatibles. It is written in compiled BASIC and data input is via automated, menu driven spreadsheets. From within the spreadsheets users can define the dimensions of a forecast, as well as the types of vehicle technologies and the fuels they use. The AMFU Model can be run for one or many vehicle types (e.g., automobiles, light trucks, heavy trucks) simultaneously. The effort required to create the data tables required for a model run is substantial. 28 refs., 3 figs., 15 tabs.

35 ARMS CONTROL

Refer also to citation(s) 37554, 37559

3501 Policy, Negotiations, and Legislation

Refer also to citation(s) 36809

37160 (DOE/DP/50066–T5) **Country statements on the nuclear non-proliferation treaty, Article 6.** Dunn, L.A.; Wolfsthal, J.B. Science Applications International Corp., McLean, VA (USA). 5 Apr 1990. 108p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC01-88DP50066. Order Number DE90012718. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The Fourth NPT Review Conference will be held from August 20 to September 14, 1990. Recent statements by key NPT member and non-member states suggest certain themes that are likely to dominate discussion of Article 6 at the 1990 Review Conference.

These common themes may be divided into two categories: the non-proliferation of nuclear weapons and nuclear and general disarmament. For the most part, they reflect the basic lines of debate at earlier NPT Review Conferences. However, two differences are evident: (1) more discussion of a step-by-step process of limiting nuclear testing; (2) considerably greater emphasis on negative security assurances. In addition, while recent US-Soviet progress on bilateral nuclear arms reductions is sometimes acknowledged, that progress appears to have done little to dampen rhetorical enthusiasm for a comprehensive nuclear test ban. This paper covers the current status and upgrade strategies for negative security assurances (NSA).

37161 (DOE/DP/50066–T8) **Bilateral agreements providing negative security assurances to states party to the Nuclear Non-Proliferation Treaty.** Carnahan, B. Science Applications International Corp., McLean, VA (USA). 9 May 1990. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC01-88DP50066. Order Number DE90012715. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

After several years of quiescence, it appears that the issue of negative security assurances will become a more prominent and contentious issue during and after the 1990 Nuclear Non-Proliferation Treaty (NPT) Review Conference. During the negotiation of the Nuclear Non-Proliferation, the non-nuclear weapon states maintained that the Treaty should include negative security assurances from the nuclear weapons states, promising that the non-nuclear weapon states would not be subject to nuclear attack if they ratified the NPT. Such assurances were not included in the NPT, but the United States, United Kingdom and the Soviet Union undertook to deal with the issue in some other form. The issue of negative security assurances remains linked to the NPT regime, however, and has been considered at prior NPT Review Conferences. This document discusses the political and military aspects of this issue.

36 MATERIALS

Refer also to citation(s) 37153

37162 (EP-LMS-RA–1988) **Solid state mechanics.** Habib, P. (Ecole Nationale du Genie Rural des Eaux et des Forets (ENGREF), 75 - Paris (FR)). Ecole Polytechnique, 91 - Palaiseau (France). 1988. 35p. (In French). Order Number DE90500833. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the Solid State Mechanics laboratory (Polytechnic School, France) is presented. The research program domains are the following: investigations concerning the stability and bifurcation of the reversible or irreversible mechanical systems, the problems related to the theoretical and experimental determination of the materials rheological properties, the fatigue crack formation and propagation in multiple-axial stress conditions, the expert systems, and the software applied in the reinforced earth structures dimensioning. Moreover, the published papers, the books, the congress communications, the thesis, and the patents are listed.

37163 Trigonal phases in $YBa_2Cu_3O_{6.5}$. Li, D.J. (Northwestern Univ., Evanston, IL (USA)); Zhang, J.P.; Thiel, J.P.; Marks, L.D. *Journal of Solid State Chemistry (USA)*, 81(2): 165-172 (Aug 1989).

Trigonal ordering is evident from electron microscopy of quenched powders of composition $YBa_2Cu_3O_{6.5}$. The powders are a mixture of phases, some of which are based upon two trigonal phases with a = 0.54 and c = 0.66 nm. In the first the yttrium and barium atoms order on the (111) planes of the parent perovskite structure rather than the (001) while in the second stacking sequence the yttrium layer of this structure is interchanged with one of the copper layers.

37164 Quasi-two-dimensional electronic properties of the monophosphate tungsten bronzes $Na_xP_4W_8O_{32}$ and $Na_xP_4W_{12}O_{44}$: Crystal growth, physical properties, and electronic band structure. Wang, E. (State Univ. of New Jersey, New Brunswick (USA)); Greenblatt, M.; El-Idrissi Rachidi, I.; Canadell, E.; Whangbo, Myunghwan. *Journal of Solid State Chemistry (USA)*, 81(2): 173-180 (Aug 1989). DOE Contract FG05-86ER45259.

Sodium monophosphate tungsten bronzes $Na_{1.6}P_4W_8O_{32}$ and $Na_2O_4W_{12}O_{44}$ were synthesized, and electrical resistivities and magnetic susceptibilities were measured. These bronzes were found to be quasi-two-dimensional metals and to exhibit weak anomalies in their electrical resistivity and magnetic susceptibility. The possible origin of these anomalies was examined in terms of the tight-binding band electronic structures calculated for the W_4O_{16} and W_6O_{22} slabs of $Na_{1.6}P_4W_8O_{32}$ and $Na_2P_4W_{12}O_{44}$, respectively.

37165 Structural and spectroscopic investigations of $LaFeAl_{11}O_{19}$ compounds. Tronc, E. (ENSCP, Paris (France)); Laville, F.; Lejus, A.M.; Vivien, D.; Gasperin, M. *Journal of Solid State Chemistry (USA)*, 81(2): 192-202 (Aug 1989).

Single crystals of nonstoichiometric $LaFeAl_{11}O_{19}$, isotypic with magnetoplumbite, have been prepared. Structural refinement and investigations by ESR and optical and Moessbauer spectroscopies have been performed. It is deduced that iron is in the 2+ state, and that Fe^{2+} ions are localized in the tetrahedral sites of the spinel blocks. By air annealing, Fe^{2+} is partially converted into Fe^{3+}. A significant amount of Fe^{3+} ions appears in trigonal bipyramidal sites.

37166 Synthesis and properties of $NdNiO_3$ prepared by low-temperature methods. Vassiliou, J.K. (Cornell Univ., Ithaca, NY (USA)); Hornbostel, M.; Ziebarth, R.; Disalvo, F.J. *Journal of Solid State Chemistry (USA)*, 81(2): 208-216 (Aug 1989).

$NdNiO_3$ has been prepared with a rhombohedral perovskite structure by low-temperature methods, and its magnetic and electric properties have been studied between 4 and 300 K. The temperature coefficient of the resistivity changes at 130 K from positive (i.e., metal-like) to negative (i.e., semiconductor-like), with some thermal hysteresis at this transition. The magnetic susceptibility shows Curie-Weiss behavior, modified by the changing thermal occupation of the Nd^{3+} crystal field levels, over the whole temperature range. Differential thermal analysis and thermogravimetric analysis showed oxygen loss beginning at 900°C in an N_2 atmosphere. Subsequent X-ray analysis at room temperature showed the presence of Nd_2NiO_4 and NiO. The electrical resistivity of sintered polycrystalline samples (1.5×10^{-2} ohm cm at 300 K) is somewhat above the expected minimum metallic conductivity, but the observation of a positive constant term in the susceptibility above 100 K suggests metallic band behavior. The hysteresis near 130 K suggests a structural distortion at low temperatures.

37167 A study of a new incommensurate phase in the system $SrMn_{1-x}Co_xO_{3-y}$. Battle, P.D. (The University, Leeds (England)); Gibb, T.C.; Strange, R. *Journal of Solid State Chemistry (USA)*, 81(2): 217-229 (Aug 1989).

The oxygen-deficient system $SrMn_{1-x}Co_xO_{3-y}$ ($0 \leq x \leq 1$) has been studied by X-ray and neutron powder diffraction, magnetic susceptibility, ^{57}Fe Moessbauer spectroscopy, and EXAFS techniques. Three new phases have been obtained, the most significant being an incommensurate phase for $0.40 \leq x \leq 0.55$ which is believed to be closely related to the family of perovskite structures with hexagonal symmetry. However, the EXAFS data show the existence of some as yet unidentified structural features which are not found in perovskites, for example a Co-Co distance of ≈ 2.8 Å. The Mn cations occupy an environment which is significantly different from that of the Co cations. At high cobalt content ($x \approx 0.8$) and high temperatures the system adopts a pseudocubic perovskite structure, with corner-shared polyhedra, which transforms on slow cooling to a poorly defined hexagonal phase containing face- and edge-shared polyhedra, similar to H-$Sr_2Co_2O_{5+z}$. There is evidence to suggest that these hexagonal phases may also be incommensurate.

37168 XPS study of the dependence on stoichiometry and interaction with water of copper and oxygen valence states in the $YBa_2Cu_3O_{7-x}$ compound. Salvador, P. (Instituto de Catalisis y Petroleoquimica, Madrid (Spain)); Fierro, J.L.G.; Amador, J.; Cascales, C.; Rasines, I. *Journal of Solid State Chemistry (USA)*, 81(2): 240-249 (Aug 1989).

In order to elucidate the valence states of both copper and oxygen in $YBa_2Cu_3O_{7-x}$ as a function of the oxygen content, their

O_{1s} and Cu_{2p} core-level X-ray photoelectron spectra were studied at room temperature for $0.9 \geq x \geq 0.1$. No evidence of the Cu^{3+} (i.e., $3d^8$) configuration was found for the ground state of a superconducting sample ($x \approx 0.1$). Rather, the ground state for this composition can be described as a mixture of two configurations: mainly $3d^9KL$ (i.e., Cu^{2+}-O^- hybridization), where K represents an electron of the conduction band and L stands for a hole in the oxygen bonded to a virtually divalent copper, and some $3d^{10}$ (i.e., Cu^+). The amount of monovalent copper was found to increase with x, as oxygen (O^- species) from Cu_1-O chains parallel to the crystallographic b axis leave the lattice and electrons are transferred to the adjacent Cu^{2+} ions. Simultaneously, the concentration of holes delocalized in the oxygen valence band decreases, the Fermi level goes upward, and the material's behavior at room temperature changes from quasi-metallic (degenerated p-type semiconductor) to p-type semiconducting. For $x \approx 0.9$ the amount of Cu^+ predominates over that of Cu^{2+}. The high reactivity of the superconducting material with water is evidenced by the special characteristics of its O_{1s} core-level spectrum. The presence of OH^- ions indicates dissociative adsorption of water molecules from the air. The XPS signal due to OH^- species is higher than that of the O^{2-} lattice ions, even when the sample was preserved from exposure to air. Moreover, when the superconducting sample was contaminated by prolonged exposition to air, the O^{2-} signal could hardly be observed.

37169 Thermoelectric power measurements of $CuCr_{2-x}Al_xO_4$ and $Cu_{1-x}Mg_xCr_2O_4$ solid solution spinel oxides. Padmanaban, N. (Indian Institute of Technology, Kharagpur (India)); Avasthi, B.N.; Ghose, J. *Journal of Solid State Chemistry (USA)*, 81(2): 250-256 (Aug 1989).

Thermoelectric power of the solid solution system $CuCr_{2-x}Al_xO_4$ for x = 0-2 was determined between 300 and 673 K. $CuCr_2O_4$ shows p-type conduction and for $x > 0.08$ it changes to n-type. The results show that this is due to the presence of Cu_{tet}^{1+} ions produced during the redistribution of cations in the spinel lattice when aluminum is substituted for chromium ions. In the p-type samples charge hopping is between Cr_{oct}^{4+} and Cr_{oct}^{3+} and in the n-type, between Cu_{tet}^{2+} and Cu_{tet}^{1+}. The samples show n-type or p-type behavior depending on the dominant charge carrier present at a particular temperature.

37170 Compound formation and phase equilibria in the system Li_4SiO_4-$LiGaSiO_4$. Quintana, P. (Univ. of Aberdeen (England)); West, A.R. *Journal of Solid State Chemistry (USA)*, 81(2): 257-270 (Aug 1989).

Four new phases have been synthesized and characterized in the system Li_4SiO_4-$LiGaSiO_4$. Three have the ideal formula $Li_5GaSi_2O_8$, one of which, δ, is a stoichiometric phase and the other two, β and γ, form in addition a range of solid solutions to either side of this composition. The β phase appears to be structurally related to γ-Li_3PO_4 and the γ phase is a low-temperature ordered form of β. The $\beta \rightleftharpoons \gamma$ transition is similar to that observed in $Li_4Zn(PO_4)_2$. The fourth new phase, α, is a solid-solution phase structurally related to γ-$LiAlO_2$. Li_4SiO_4 forms an extensive range of solid solutions which gradually transform to the α structure with increasing $LiGaSiO_4$ content. Low-temperature, ordered forms of the α solid solutions and the Li_4SiO_4 solid solutions have been partially characterized. The complete phase diagram Li_4SiO_4-$LiGaSiO_4$ has been determined; the system behaves as binary except at compositions close to $LiGaSiO_4$ at which $LiGa_5O_8$ appears in partially melted samples.

37171 Short-range order in the $Ca_{1-x}La_xF_{2+x}$ solid solution: 1:0:3 or 1:0:4 clusters?. Laval, J.P. (CNRS, Limoges (France)); Abaouz, A.; Frit, B. *Journal of Solid State Chemistry (USA)*, 81(2): 271-277 (Aug 1989).

The defect structure of the $Ca_{1-x}La_xF_{2+x}$ solid solution ($0 \leq x \leq 0.38$) has been examined at room temperature by powder neutron diffraction. Two kinds of (xxx) interstitial anions, whose respective numbers increase linearly with increasing dopant cation concentration, have been found: one labeled F^0 ($x \approx 0.41$) is a true interstitial; the other labeled F''' ($x \approx 0.31$) can be considered a relaxed normal anion. Two 1:0:n defect clusters are compatible, within the experimental errors, with these results: the 1:0:3 ($1V_F$, OF', $3F''$, $2\ La^{3+}$) and the 1:0:4 ($1V_F$, OF', $4F''$, $3La^{3+}$) clusters. Charge balance considerations and comparisons with the homologous $Ca_{1-x}M_x^{IV}F_{2+2x}$ solid solutions (M^{IV} = Th, U) allow us to think that the less dense 1:0:3 cluster is present for the whole domain of both kinds of solid solutions.

37172 Structure of the dimer compounds $Cs_3R_2Br_9$ (R = Tb, Dy, Ho, Er, Yb) at 8 and 295 K studied by neutron diffraction. Doenni, A. (ETH Zuerich, Wuerenlingen (Switzerland)); Furrer, A.; Guedel, H.U. *Journal of Solid State Chemistry (USA)*, 81(2): 278-284 (Aug 1989).

The structure of the dimer compounds $Cs_3R_2Br_9$ (R = Tb, Dy, Ho, Er, Yb) has been determined by powder neutron diffraction at 8 and 295 K. Rietveld refinements within the trigonal space group $R\bar{3}c$ show an anisotropic thermal expansion of the lattice parameters. With increasing temperature the dimeric units $R_2Br_9^{3-}$ become increasingly isolated and separated in the lattice. The intradimer distances can be rationalized with simple electrostatic arguments.

37173 Crystal structure of $Sr_{10}Al_2F_{25}Cl$. Hemon, A. (Universite du Maine, Le Mans (France)); Courbion, G. *Journal of Solid State Chemistry (USA)*, 81(2): 293-298 (Aug 1989).

$Sr_{10}Al_2F_{25}Cl$ is cubic (space group Fd3m) with a = 16.4209(3) Å and Z = 8. The structure is refined from 386 reflections to R = 0.022 R_w = 0.018. Aluminum ions are in octahedral sites while strontium atoms are in 10- (Sr_1) and 8- (Sr_2) fold coordination. The structure is characterized by two interpenetrated three-dimensional networks: one built from SrF_8 polyhedra and the other from four SrF_{10} polyhedra blocks connected together by aluminum octahedra. The chlorine atoms are octahedrally surrounded by six Sr_2.

37174 Crystal structure of $Na_3Sr_4Al_5F_{26}$. Hemon, A. (Universite du Maine, Le Mans (France)); Le Bail, A.; Courbion, G. *Journal of Solid State Chemistry (USA)*, 81(2): 299-304 (Aug 1989).

$Na_3Sr_4Al_5F_{26}$ is tetragonal (space group $P4_2/n$) with a = 10.2679(5) Å, c = 18.373(2) Å, and Z = 4. The structure is refined, despite a systematic twinning, from 1478 reflections to R_F = 0.029 (R_1 = 0.039). Aluminum ions are in octahedral sites while strontium and sodium atoms are respectively in nine- and eightfold coordination. The structure is characterized by isolated $[Al_5F_{26}]^{11-}$ pentamers. A distorted cube $[Na_{(1)}F_8]^{7-}$ ensures the connection between the octahedra pentamers and builds up $[NaAl_5F_{26}]^{10-}$ chains running along the b-axis at level z = 0 and along the a-axis at level $z = \frac{1}{2}$. Strontium ($Sr_{(1)}$ and $Sr_{(2)}$) and sodium ($Na_{(2)}$ and $Na_{(3)}$) are inserted between the chains.

37175 Syntheses and crystal structures of the α- and β-forms of the orthoborate $Sr_2Cu(BO_3)_2$. Smith, R.W. (Oregon State Univ., Corvallis (USA)); Keszler, D.A. *Journal of Solid State Chemistry (USA)*, 81(2): 305-313 (Aug 1989).

The low-temperature α-form and the high-temperature β-form of the compound of formula $Sr_2Cu(BO_3)_2$ have been synthesized and their structures established by single-crystal X-ray methods. The α-phase crystallizes in a monoclinic cell of dimensions a = 5.707(1), b = 8.796(2), c = 6.027(1) Å, and β = 116.98(1)° with Z = 2; the space group is $P2_1/c$. The structure was determined from 1039 independent reflections and refined to the final residuals R = 0.037 and R_w = 0.051. It is composed of sheets of isolated CuO_4 square planes that are rotated out of the b-c plane and connected by BO_3 and SrO_7 units; it is isomorphous to the compound $Na_2Cu(CO_3)_2$. The β-phase crystallizes in an orthorhombic cell of dimensions a = 7.612(3), b = 10.854(7), c = 13.503(4) Å with Z = 8; the space group is Pnma. The structure was determined from 1235 independent reflections and refined to the final residuals R = 0.030 and R_w = 0.039. This structure exhibits isolated units of stoichiometry $Cu_2(BO_3)_4$ that are built from CuO_4 distorted square planes and triangular BO_3 groups. These units are bridged by three crystallographically independent Sr atoms. The phase transition from the α-phase to the β-phase occurs at 800°C. Considerable bond scission and reformation between two phases indicate that the transition is first order.

37176 An anti-stokes vibronic line in the emission spectrum of LaF_3:Gd. Blasse, G. (Univ. of Utrecht (Netherlands)); Brixner,

L.H. *Journal of Solid State Chemistry (USA)*, 81(2): 314-316 (Aug 1989).

The emission spectrum of LaF_3:Gd shows an anti-Stokes vibronic line coupled to the $^6P_{7/2} \rightarrow {}^8S$ transition. Recently we have shown that X-ray excitation of Gd^{3+}-containing compositions can yield very efficient Gd^{3+} emission (4, 5). In this way it is possible to study vibronic transitions in the Gd^{3+} emission spectra. The fact that the ground state (^8S) of the Gd^{3+} ion is not split makes it easy to observe and interpret these spectra. In view of our results with Stokes vibronics on the $^6P_{7/2} \rightarrow {}^8S$ electronic transition of the Gd^{3+} ion, we tried to observe also the anti-Stokes emission.

37177 Revisiting kaolinite dehydroxylation: A ^{29}Si and ^{27}Al MAS NMR study. Lambert, J.F. (Univ. of Wisconsin, Madison (USA)); Millman, W.S.; Fripiat, J.J. *Journal of the American Chemical Society (USA)*, 111(10): 3517-3522 (10 May 1989).

The ^{29}Si and ^{27}Al MAS NMR spectra of kaolinite are easily interpreted in terms of a Q^3 environment for silicon and of an octahedral configuration of aluminum. Upon progressive dehydroxylation, these spectra become more complex. For a degree of dehydroxylation (α) between 1/10 and 9/10, three ^{27}Al resonances are observed at +3, +28, and +55 ppm. The octahedral component decreases in intensity as α increases, whereas the other two become dominant. The line at +28 ppm is assigned to pentacoordinated Al, as suggested by Gilson et al. The +55-ppm line is attributed to tetrahedrally coordinated Al. Simultaneously, the −91-ppm (initial) component of the ^{29}Si spectrum decreases in intensity, while at least two components corresponding to more shielded Si nuclei grow in intensity. As α increases beyond 9/10, further shifts are observed in the ^{29}Si spectra as mentioned by Meinhold et al. Ultimately a line at −109 ppm suggests a significant proportion of the ^{29}Si nuclei being in a Q^4 environment, while the ^{27}Al spectrum is reminiscent of that of a spinel-like material. The relationships between the ^{29}Si and ^{27}Al spectra are discussed and compared with IR data in the 1,200-400-cm^{-1} range and with earlier results on ^1H (static) NMR.

37178 Evidence for hole injection from $O_2(^1\Delta)$ into p-Si. Graetzel, M. (Lawrence Berkeley Lab., CA (USA)); Frei, H. *Journal of Physical Chemistry (USA)*, 93(20): 7037-7041 (5 Oct 1989).

A cathodic photocurrent has been observed at a single-crystal p-Si electrode upon sensitization of methylene blue in air-saturated acetonitrile solution by red light. The photocurrent action spectrum agrees well with the absorption spectrum of monomeric methylene blue. A 2-3-fold enhancement of the sensitized photocurrent was observed when CH_3CN was replaced by CD_3CN. Simultaneous monitoring of $O_2(^1\Delta)$ lifetimes in electrolyte solutions by time-resolved measurement of the $O_2\ ^1\Delta \rightarrow {}^3\Sigma^-$ emission at 1.3 μm revealed a solvent isotope lifetime effect identical with the photocurrent isotope ratio. This finding, and the observed quenching of the photocurrent upon addition of the known singlet O_2 quencher sodium azide, indicate that the photocurrent is caused by hole injection from sensitized O_2 ($^1\Delta$) into the valence band of the semiconductor.

3601 Metals and Alloys

Refer also to citation(s) 36690, 36691, 36692, 36735, 36744, 36746, 36747, 36748, 36749, 36750, 36751, 36752, 36766, 36869, 36890, 36907, 36912, 36935, 36990, 36992, 36993, 36995, 37164, 37165, 37166, 37167, 37169, 37170, 37171, 37172, 37173, 37174, 37175, 37176, 37236, 37290, 37332, 37955, 37979, 37987, 38097, 38126, 38327

37179 (CONF-900466–60) **Diffusion-accommodated grain boundary sliding in a polycrystal.** Hazzledine, P.M.; Schneibel, J.H. Oak Ridge National Lab., TN (USA). [1990]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Spring meeting of the Materials Research Society; San Francisco, CA (USA); 16-21 Apr 1990. Order Number DE90012727. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A two-dimensional model for diffusional creep (Coble creep) and diffusion-accommodated grain boundary sliding in polycrystals has been developed. The results obtained for small symmetrical clusters of grains reproduce Spingarn and Nix's work [Acta Metall. 26, 1389 (1978)]. For clusters of irregularly shaped grains the material deposition and removal rates, the fluxes along the grain boundaries, the grain boundary tractions as well as the grain boundary sliding rates are irregular and can all be calculated. 4 refs., 5 figs.

37180 (CONF-900466–67) **Formation of cubic Ll_2 phases from Al_3Ti and Al_3Zr by transition metal substitutions for Al.** Sparks, C.J.; Porter, W.D.; Schneibel, J.H.; Oliver, W.C.; Golec, C.G. Oak Ridge National Lab., TN (USA). [1990]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Spring meeting of the Materials Research Society; San Francisco, CA (USA); 16-21 Apr 1990. Order Number DE90012288. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Alloys of $(Al_xM_{1-x})_3Ti$ where M is V, Cr, Mn, Fe, Co, Nb, W, Fe + Ga or Fe + Ga + Mn were fabricated to form the Ll_2 cubic phase, tested for ductility, and characterized by lattice parameter, microstructure, quantitative phase analysis, and phase composition. The elements V, Co, Nb, W, Fe + Ga and Fe + Ga + Mn are hereby newly found Ll_2 formers in Al_3Ti. Both x-ray diffraction and microprobe analysis were used to identify the phases, their volume fractions and compositions. The amount of ternary addition found in the Ll_2 cubic phase varied between 4 and 12 atomic percent. This amount of ternary addition decreased as the atomic radius of the elemental addition increased. Pettifor's Mendeleev number was a useful guide in the selection of elements to form the Ll_2 phase but did not correlate strongly with the amount of the ternary addition. For the DO_{23} phase of Al_3Zr, the elements V, Mn, and Co were added to the list of Ni, Cu, Fe, and Cr as elements known to form the Ll_2 phase. Little if any ductility was observed in these cubic Ll_2 phases which readily cleaved with transgranular failure. To achieve ductility and toughness, more than transformation of these compositions from a lower to a higher symmetry crystal structure will be required. 15 refs., 3 figs., 2 tabs.

37181 (CONF-900756–5) **Vacuum outgassing from diffuse-absorptive baffle materials.** Egert, C.M. (Oak Ridge National Lab., TN (USA)); Basford, J.A. Oak Ridge National Lab., TN (USA). [1990]. 12p. Sponsored by U.S. Department of Defense; U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From SPIE's international symposium on optical and optoelectronic applied science and engineering and exhibit; San Diego, CA (USA); 8-13 Jul 1990. Order Number DE90012600. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Measurements of outgassing have been made from Martin black and a variety of diffuse absorptive baffle materials under development for radiation resistant stray light management. Outgassing measurements were made during pumpdown from atmosphere at room temperature. Mass scans indicate water was the major outgassing species for all materials tested. Calibrated measurements of water vapor outgassing as a function of time were also made for each baffle material. Most baffle materials exhibited total water vapor outgassed during pumpdown of between 1×10^{-5} and 4×10^{-5} moles/cm^2. Plasma sprayed beryllium currently under development exhibited approximately an order of magnitude lower total water vapor outgassed during pumpdown. 7 figs., 2 tabs.

37182 (CONF-900756–8) **Diffuse absorbing beryllium coatings produced by magnetron sputtering.** Egert, C.M. (Oak Ridge National Lab., TN (USA)); Allred, D.A. Oak Ridge National Lab., TN (USA). [1990]. 15p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. From SPIE's international symposium on optical and optoelectronic applied science and engineering and exhibit; San Diego, CA (USA); 8-13 Jul 1990. Order Number DE90012945. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Beryllium coatings with varying thicknesses and columnar grain sizes were deposited by low temperature magnetron sputtering and then wet chemically etched to enhance diffuse absorption of light. After etching these coatings exhibited a mate black surface finish and low specular reflectance (below 2%) in the IR up to a critical wavelength dependent upon the original grain size of the coating. Extremely thick coatings (300 um) with original grain sizes of 10 to 12 um have been produced which exhibited specular reflectances below 0.5% up to 50 um wavelength and a Lambertian BRDF at 10.6 um averaging 4.3×10^{-3} $ster^{-1}$. Scanning electron microscopy results are presented for etched and unetched beryllium

coatings which showed the etching process produces roughness and porosity over several size scales simultaneously with the maximum size scale limited by the initial coating grain size. This technique for producing diffuse absorbing baffle materials has great versatility in choice of coating material and substrate and can be expected to provide optical system designers with a variety of material options for stray light management.

37183 (CONF-900886–1) **Oxidation and sulfidation of Type 310S stainless steel at elevated temperatures.** Wolf, J.S. (Clemson Univ., SC (USA). Dept. of Mechanical Engineering); Cavin, O.B. Oak Ridge National Lab., TN (USA). [1990]. 23p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 29. international symposium on high temperature oxidation and sulfidation processes; Hamilton (Canada); 26-30 Aug 1990. Order Number DE90010149. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Specimens of Type 310S stainless steel in the forms of thin flat and bent sheet (ells) were exposed either to air or a sulfidizing atmosphere at temperatures near 900°C. An attempt was made to determine the relationships between: (a) the scale structure, (b) the rate of reaction and (c) the mechanical stresses generated during exposure. The investigative techniques used included: room and elevated temperature x-ray diffraction, optical and electron microscopy as well as optical determinations of specimen deformations. Protective and spall-resistant scales were formed in both atmospheres. All scales were composed of an inner sesquioxide and an outer spinel layer. Both the scale crystallinity and the surface topography were, however, grossly different in the two environments; including especially the presence of metallic particles found embedded in the scales of sulfidized specimens. The interaction of sulfur with the growth of oxide scales apparently alters their crystallinity, microstructure and stress state. It is suggested that the oxide grain boundary plays a role in this perturbed growth process and that, therefore, the control of oxide grain size may be one fruitful approach in the future development of alloys resistant to breakdown in sulfidizing atmospheres. 29 refs., 8 figs., 7 tabs.

37184 (DOE/ER/45214–5) **Twin boundaries, interfaces and modulated structures in martensites: Annual progress report No. 5, July 1, 1989–June 30, 1990.** Barsch, G.R. Pennsylvania State Univ., University Park, PA (USA). Materials Research Lab. 15 Jan 1990. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER45214. Order Number DE90012899. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A comprehensive theoretical study with concurrent supporting experimental investigations is being carried out on coherent and semicoherent interfaces in ferroelastic martensites, including twin boundaries and twin bands, heterophase parent/product interfaces and inclusions, and transformation precursors. This work is motivated by the need for a new theoretical basis for investigating the martensite nucleation mechanism and for establishing the conditions for nonclassical nucleation. Soliton-like solutions of a dynamic Ginzburg-Landau continuum theory for ferroelastic martensites are being studied in order to determine the strain distribution, strain energy and dynamical behavior for various geometric configurations as a function of the material parameters, temperature and boundary conditions. Model parameters of the theory consist of the second and higher order elastic constants and the harmonic strain gradient coefficients in the parent phase. X-ray measurements of the transformation strain versus temperature, and ultrasonic velocity and attenuation measurements on biaxially stressed crystals in $In_{1-x}Tl_x$ alloys for determining the second and higher order elastic constants in the single domain tetragonal state and for studying the morphology and the dynamic behavior of the martensite interfaces and transformation precursors are in progress.

37185 (DOE/ER/45355–2) **Microstructural dependence of the cavitation damage function in FCC materials: Progress report, March 1, 1989–February 28, 1990.** Adams, B.L. Yale Univ., New Haven, CT (USA). Dept. of Mechanical Engineering. 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER45355. Order Number DE90012898. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report discusses progress made by the experimental and theoretical programs. The experimental program over the past year has concentrated on establishing optimal testing conditions for creep testing, and on characterization of the starting microstructure of the high purity copper sheet. (JDL)

37186 (EP-LOA-RA–1988) **Applied optics.** Orszag, A. (Ecole Nationale Superieure de Techniques Avancees, 75 - Paris (FR)); Antonetti, A. Ecole Polytechnique, 91 - Palaiseau (France). 1988. 23p. (In French). Order Number DE90500836. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report, of the Applied Optics laboratory, of the (Polytechnic School, France), is presented. The optical fiber activities are focused on the development of an optical gyrometer, containing a resonance cavity. The following domains are included, in the research program: the infrared laser physics, the laser sources, the semiconductor physics, the multiple-photon ionization and the nonlinear optics. Investigations on the biomedical, the biological and biophysical domains are carried out. The published papers and the congress communications are listed.

37187 (EP-OPTQ-RA–1988) **Quantum optics.** Flytzanis, C. (Centre National de la Recherche Scientifique (CNRS), 75 - Paris (FR)). Ecole Polytechnique, 91 - Palaiseau (France). 1988. 17p. (In French). Order Number DE90500838. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the Quantum Optics laboratory (Polytechnic School, France) is presented. The research program is focused on the behavior of dense and dilute materials submitted to short and high-intensity light radiation fields. Nonlinear optics techniques, with time and spatial resolution, are developed. An important research activity concerns the investigations on the interactions between the photon beams and the inhomogeneous or composite materials, as well as the artificial microstructures. In the processes involving molecular beams and surfaces, the research works on the photophysics of surfaces and the molecule-surface interactions, are included.

37188 (EP-PMC-RA–1988) **The condensed matter physics.** Sapoval, B. (Centre National de la Recherche Scientifique (CNRS), 75 - Paris (FR)). Ecole Polytechnique, 91 - Palaiseau (France). 1988. 21p. (In French). Order Number DE90500839. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the laboratory of the Condensed Matter Physics (Polytechnic School, France), is presented. The Laboratory activities are related to the physics of semiconductors and disordered phases. The electrical and optical properties of the semiconductors, mixed conductor, superionic conductors and ceramics, are studied. Moreover, the interfaces of those systems and the sol-gel inorganic polymerization phenomena, are investigated. The most important results obtained, concern the following investigations: the electrochemical field effect transistor, the cathodoluminescence, the low energy secondary electrons emission, the fluctuations of a two-dimensional diffused junction and the aerogels.

37189 (IS-T–1354) **Searching for heavy fermion materials in Ce intermetallic compounds.** Tang, Jinke. Ames Lab., IA (USA). Jan 1990. 144p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90011809. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

The low temperature heat capacity, magnetic susceptibility and electrical resistivity were studied for a series of Ce intermetallic compounds. No heavy fermion behavior was found in these compounds. $CePtGa_3$ has a rounded peak at ~1.7K in its heat capacity, which is shifted to higher temperatures in magnetic fields (~6K at 9.8T). The origin of this peak is believed to be due to a spin glass type transition. $CeCd_{11}$ has an unusual temperature dependence of its heat capacity which is due to a crystalline electric field (CEF) effect which occurs at an exceptionally low temperature. The CEF effect also plays an important role in $CeGa_2$. Antiferromagnetic phase transitions were found in $CeHg_3$, $CeCd_2$, $CeCd_3$ and $CeNi_{12}B_6$. Discussions on the low temperature behaviors of these and other Ce intermetallic compounds are given.

37190 (IS-T–1471) **Phase transitions in CsCl-type intemetallic compounds.** Chen, Bai-Hao. Ames Lab., IA (USA). 13 Jun 1990. 165p. Sponsored by U.S. DOE Energy Research. DOE

Contract W-7405-ENG-82. Order Number DE90012446. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

Phase transitions in binary intermetallic compounds with the CsCl-type structure have been studied by a novel combination of high-temperature powder X-ray diffraction and Rietveld Landau theory of symmetry and phase transitions and the Gibbs-Knonvalow equation have been applied to understand the phase behavior of some systems with the CsCl-type structure. The nonstoichiometric compounds RhTi, NbRu, and RuTa with the CsCl-type structure at high temperature undergo thermal symmetry breaking transitions upon cooling. The transitions are first to the AuCu-type tetragonal, and taken to the orthorhombic NbRu-type with Cmmm symmetry. Alloys Ir-Ti which are titanium rich have the CsCl-type structure. This cubic structure transforms to the AuCu-type tetragonal structure and then to the NbRu-type structure with increasing atomic percent iridium. New partial phase diagrams for the composition ranges in near equiatomic MnAu, NbRu, and RuTa are also presented.

37191 (LA-UR-90-1068) **Texture of materials by time-of-flight neutron diffraction.** Von Dreele, R.B. Los Alamos National Lab., NM (USA). [1990]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-900884-1: 14. conference on applied crystallography, Cieszyn (Poland), 5-8 Aug 1990). Order Number DE90008968. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Time-of-flight (TOF) neutron diffraction as performed at a spallation neutron source such as LANSCE offers special features that makes it potentially useful for the determination of the texture (preferred orientation, particle size and strain) of polycrystalline materials. 4 refs., 6 figs.

37192 (ORNL-6601) **Metals and Ceramics Division progress report for period ending September 30, 1989.** Oak Ridge National Lab., TN (USA). Apr 1990. 166p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC05-84OR21400. Order Number DE90012049. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This report provides a brief overview of the activities and accomplishments of the Metals and Ceramics Division during FY 1989. The division is organized to provide technical support, primarily in the area of structural materials, for the various technologies being developed by the US Department of Energy (DOE). Activities span the range from basic research (through applied research and engineering development) to industrial research (through cooperative research and a strong technology transfer program). The division is organized in functional groups that encompass nearly all of the disciplines needed to develop and to apply materials in structural applications. Sections 1 through 4 describe the different functional groups; Sect. 5 provides an alternative view of the division in terms of the major programs, most of which cross group lines; and Sect. 6 summarizes external interactions including cooperative research programs and technology transfer activities. Appendices describe the organizational structure, note personnel changes, present honors and awards received by division members, and contain listings of publications completed and presentations made at technical meetings.

37193 (ORNL/TM-11159) **Crystal growth and deformation behavior of TiAl aluminides.** Oliver, B.F.; Huang, B.Y.; Oliver, W.C. Oak Ridge National Lab., TN (USA). Apr 1990. 32p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90012972. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This work focuses on the development of single-phase TiAl based alloys. The work has three segments: processing, mechanical testing, and alloying characteristics. The processing consists of developing a technique for growing large, high-purity single crystals. Some of these crystals have been tested to determine their hardness and compression strength. The microstructures of the compressed specimens will be discussed. Finally, two important preliminary findings of the alloy development program concerning additions of gallium and manganese will be discussed. 26 refs., 19 figs., 1 tab.

37194 (PR-187-821) **Pulsed-gas-metal-arc welding (PGMAW) of API 5LX-80 pipe: Final report.** Microalloying International, Inc. (USA). ©Jan 1990. 29p. Sponsored by American Gas Association. Available from American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209 $50.00.

One objective of this program was to evaluate various shielding gases for use with the PGMAW process on API 5LX-80 pipe. Three girth welds were deposited with the PGMAW process using the CRC-Evans welding system in 30-inch-diameter, 0.750-inch wall, X-80 pipe made by Mannesmann. The three shielding gases were: (1) 95 Ar–5 CO_2, (2) 80 Ar–20 CO_2, and (3) 82.5 Ar–12.5 CO_2–5 He. The weld made with the 95 Ar–5 CO_2 shielding gas had the highest Charpy V-Notch weld-metal toughness (148-foot-pounds average, at 14F) with the toughnesses of the 80 Ar–20 CO_2 and tri-mix shielding gas welds being about the same (109.7- and 1.7.7-foot-pounds, average, respectively). The arc lengths with the argon–CO_2 mixes were longer than with the tri-mix gas. These longer arcs allowed the arc to be deflected to the side wall, promoting weld defects. The helium addition shortened the arc, increased the weld penetration, and stiffened the arc column, thus providing the best operating characteristics. So, the tri-mix gas was selected for the continuing work.

37195 (RFP-4072) **Fabricating vanadium sheet to improve symmetry of drawn parts.** Edstrom, C.M. Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant. 31 Dec 1989. 22p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC34-90DP62349. Order Number DE90011253. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The degree of anisotropy in vanadium sheet determines the amount of earing in formed parts and relates to the roundness of the formed part. Experiments with annealing and rolling practices to produce vanadium sheet were undertaken to reduce the earing tendencies of the metal. Earing in formed vanadium hemishells was reduced by cross rolling; and for unidirectionally rolled sheet, increased reduction per rolling pass and proper selection of intermediate annealing temperature reduced the earing. These modifications in the production steps did not adversely affect the grain size or formability of the vanadium, since these characteristics are mostly influenced by the final anneal. 4 refs., 10 figs., 5 tabs.

37196 (SAND-89-2857C) **Molecular dynamics simulations of grain-boundary diffusion for varying tilt angle geometries.** Plimpton, S.J. Sandia National Labs., Albuquerque, NM (USA). [1990]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. (CONF-900466-65: Spring meeting of the Materials Research Society, San Francisco, CA (USA), 16-21 Apr 1990). Order Number DE90012919. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The effect of structure and geometry on grain boundary self-diffusion is investigated. Using static structures found by relaxation techniques (conjugate gradients) as starting points for a molecular dynamic simulation of a bicrystal model, diffusion coefficients and activation energies are calculated for (100) fcc Al and bcc α-Fe tilt boundaries. These quantities are derived by monitoring the mean-squared displacement of atom in the grain boundary region as the simulation progresses and the temperature of the simulated solid is changed. The angular, directional, and structural dependence of the simulated diffusion are discussed and compared to experimental measures and theoretical predictions. The implementation of the molecular dynamics algorithm on a parallel supercomputer is also briefly discussed to illustrate the performance benefits these computers make possible. 15 refs., 4 figs.

37197 (SAND-90-8217) **Compendium of material test results on HY-130 and Ti-3Al-2V metals in support of United States Navy programs: Interim report.** Korellis, J.S.; Lee, K.L. Sandia National Labs., Livermore, CA (USA). Jun 1990. 41p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DR00789. Order Number DE90011754. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report documents the status of ongoing tests performed to construct a material database for use in structural analysis codes. Uniaxial tension and compression tests were performed to quantify isotropy and strain-rate dependence of stress-strain behavior at room temperature. Notched tensile tests were performed to support

development of the damage portion of coupled flow-damage constitutive models. The above results, supplemented with a few elevated temperature tests, will be used to define all material constants in a constitutive model. Plate perforation tests were also performed, to be compared with model predictions. 2 refs., 23 figs.

37198 (UCRL–102520) **Material characteristics related to the fracture and particulation of electrodeposited-copper shaped charge jets.** Lassila, D.H. Lawrence Livermore National Lab., CA (USA). Apr 1990. 14p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-900818–1: International conference on shock wave and high-strain-rate phenomena in materials, San Diego, CA (USA), 12-17 Aug 1990). Order Number DE90009950. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Shaped charges with two different types of electrodeposited copper liners have been found to produce fragmented and particulated jets of poor quality. Results of tensile testing and chemical analysis of fracture surfaces of these materials show that segregated impurities cause grain boundary embrittlement (loss of ductility) under tensile loading. Increase in the embrittlement occurs with increase in test temperature over some temperature ranges. Good correlation between the fracture behavior and chemical analysis of the fracture surfaces of the materials and the degree of jet fracture and particulation is observed. This correlation suggests fracture and particulation of the shaped charge jets is primarily due to the segregated impurities in the electrodeposited materials. Results of the study suggest tensile testing at elevated temperature can be used to screen liner materials for optimum performance. 18 refs., 12 figs., 3 tabs.

37199 (VTT-TUTK–639) **Characteristics of the IAEA correlation monitor material for surveillance programmes.** Wallin, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio); Valo, M.; Rintamaa, R.; Toerroenen, K.; Ahlstrand, R. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Aug 1989. 56p. Order Number DE90631154. Available from NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

Within the IAEA Coordinated Research Programme on optimizing of reactor pressure vessel surveillance programmes and their analysis, phase 3, a specially tailored 'radiation sensitive' correlation monitor material has been fabricated. This material will serve as a reference to the IAEA programme for future vessel surveillance programmes throughout the world. An extensive evaluation of the correlation monitor material in the as-received condition has been carried out in Finland and the results are presented here. The mechanical properties measured at different temperatures include Charpy V notch and instrumented precracked Charpy data, and elastic-plastic fracture toughness (J). The specimen size and geometry have been varied in the tests. Correlation between different fracture properties are evaluated and discussed.

37200 **Stability of laser-induced retained austenite in ductile iron.** Chen, C.H. (Inland Steel Co., E. Chicago, IL (US)); Ju, C.P.; Rigsbee, J.M. pp. 143-154 of Surface modification technologies II. Sudarshan, T.S.; Bhat, D.G. The Metallurgical Society Inc., Warrendale, PA (USA) (1989). (CONF-8809211–: 2. international conference on surface modification technologies, Chicago, IL (USA), 25-28 Sep 1988).

Surface modification and stability of laser-induced retained austenite in a ductile iron has been studied. A 10 kW of CO_2 continuous wave laser has been used to modify and refine the near-surface microstructure of the ductile iron for hardness and wear resistance enhancement. Depending on processing parameters, various types of dendritic and lamellar microstructures can be produced by laser processing. The dendritic microstructure, consisting of primary retained austenite dendrites with a nearly continuous interdendritic carbide film, is generally produced at high solidification/cooling rates. This laser- induced retained austenite is thermally and mechanically metastable and undergoes martensitic transformation when plastically deformed or quenched to low temperatures. Besides the usual bct martensite, a stress-induced hexagonal close packed type epsilon-martensite is also observed in the near surface regions of wear tested or cold rolled samples. This paper discusses such martensitic transformations, with emphasis placed on the stress-induced microstructural modifications, occurring in the laser-processed dendritic layer of ductile iron.

37201 **The use of high power lasers in surface modifications.** Vesely, E.J. (Surface Engineering Center, IIT Research Inst., Chicago, IL (US)); Verma, S.K. pp. 117-124 of Surface modification technologies II. Sudarshan, T.S.; Bhat, D.G. The Metallurgical Society Inc., Warrendale, PA (USA) (1989). (CONF-8809211–: 2. international conference on surface modification technologies, Chicago, IL (USA), 25-28 Sep 1988).

Results obtained in two areas of surface modification using a high power laser are reviewed: phase transformation and compositional transformation. The phase transformation process takes advantage of a solid or liquid state phase change, by using selective heating and quenching attainable with a laser. An example of such heat treating is laser processing of selective areas of a steel part with an annealed or normalized structure to form a hard martensite structure in those areas. In the compositional transformation process, the surface is melted and combined with alloying elements to form a surface with a new chemistry. The new surface can have a composition close to (by laser alloying) or completely different from (by laser cladding) the base alloy.

37202 **Deposition and adhesion of PECVD boron coatings on Ti-6Al-4V substrates.** Cooper, C.V. (United Technologies Research Center, East Hartford, CT (US)); Shuskus, A.J.; Couher, M.E.; Cipolli, R. pp. 215-230 of Surface modification technologies II. Sudarshan, T.S.; Bhat, D.G. The Metallurgical Society Inc., Warrendale, PA (USA) (1989). (CONF-8809211–: 2. international conference on surface modification technologies, Chicago, IL (USA), 25-28 Sep 1988).

Plasma-enhanced chemical vapor deposition (PECVD) has been used to produce elemental boron coatings on Ti-6Al-4V substrates. Deposition has been accomplished using a novel PECVD reactor in which a serpentine, rather than a helical, RF coil has been employed. Transmission electron microscopy has confirmed the amorphous nature of these boron coatings. Scratch adhesion properties of this coating/substrate system, including an investigation of the effects of nitrogen ion implantation energy and fluence prior to deposition, have been determined. Both acoustic emission and frictional force measurements have been recorded during scratch removal traverses to detect incipient coating and/or substrate failure. Differences in failure mechanism have been found to result as a consequence of the substrate surface pretreatment, with untreated substrates giving rise to adhesive failures and ion implanted substrates leading to cohesive coating failures. The acoustic emission technique has demonstrated great sensitivity in the detection of both adhesive and cohesive coating failures, and scanning electron microscopy has been effective in differentiating adhesive failures, such as spallation, from coating microcracking in a cohesive failure mode.

37203 **Effects of deformation (strain) and heat treatment on grain boundary sensitization and precipitation in austenitic stainless steels.** Murr, L.E. (Texas Univ., El Paso, TX (USA)); Advani, A.; Shankar, S.; Atteridge, D.G. *Materials Characterization (USA),* 24(2): 135-158 (Mar 1990).

Sensitization, particularly the degree of sensitization (DOS) in type 316 stainless steel pipe is critically dependent upon the solution anneal of the mill-annealed or commercial material, and is particularly sensitive to los-temperature aging when the starting material is solution annealed between about 1,000°C and 1,100°C. It is observed that when the DOS is above about 10 C/cm^2 (quantitative electrochemical photentiokinetic reactivation units in Coulombs/cm^2), noticeable carbide precipitation occurs in the grain boundaries and increases with increasing DOS. Transmission electron microscopy (TEM) examination of precipitation occurring in type 316 stainless steel pipe grain boundaries has shown them to exhibit many microstructural features that seem to be coincident with grain boundary microstructures, particularly ledges.

37204 **A comparative study of $V_6O_{13.27}$ and V_6O_{13}.** Bose, M. (Bose Institute, Calcutta (India)); Basu, A. *Journal of Solid State Chemistry (USA),* 81(2): 147-151 (Aug 1989).

A comparative study of the oxygen-enriched $V_6O_{13.27}$ and stoichiometric V_6O_{13} is made from susceptibility and ^{51}V NMR. Instead of a susceptibility peak at 150 K as in V_6O_{13}, a plateau was observed in this region. A single broad ^{51}V NMR line was observed in $V_6O_{13.27}$ at room temperature, which narrowed on lowering of temperature. Close to 150 K, three different lines, corresponding to the three inequivalent sites as in V_6O_{13}, were observed. Though occurrence of spin-pairing at 150 K has been recognized for some time, a bipolaronic mechanism for this pairing in V_6O_{13} itself is proposed for the first time. Interestingly, though susceptibility wise $V_6O_{13.27}$ and V_6O_{13} show very different behavior, bipolaronic spin-pairing possibly occurs in $V_6O_{13.27}$ also. However, at 50 K, antiferromagnetic ordering as in V_6O_{13} does not occur in $V_6O_{13.27}$ as the latter has fewer V^{4+} spins than required, due to the presence of excess oxygen.

37205 Nanoindentation study of the mechanical properties of copper-nickel multilayered thin films. Cammarata, R.C. (Department of Materials Science and Engineering, The Johns Hopkins University, Baltimore, Maryland 21218 (USA)); Schlesinger, T.E.; Kim, C.; Qadri, S.B.; Edelstein, A.S. *Applied Physics Letters (USA),* 56(19): 1862-1864 (7 May 1990). DOE Contract AC05-76OR00033.

The mechanical properties of multilayered Cu-Ni thin films with bilayer thicknesses of 1.6–12 nm were investigated by a nanoindentation technique. Force-displacement curves generated during loading and unloading of a diamond tip indenter were used to determine the hardness and elastic properties of the films. No enhancement in the elastic properties (supermodulus effect) was seen, but an enhancement in the hardness was observed. It is suggested that the enhancement, which displayed a Hall–Petch-type behavior, can be understood as owing to dislocation pinning at the interfaces analogous to the mechanism of grain boundary hardening.

37206 Enhanced ordering and stability of Pd_8W in proton irradiated Pd-W alloys. Cheng, J. (Dept. of Materials Science and Engineering, Univ. of California, Los Angeles, CA (US)); Ardell, A.J. *Acta Metallurgica (USA),* 37(7): 1891-1902 (Jul 1989).

Irradiation enhanced ordering of Pd_8 W was studied in binary alloys, most of which contained 10 at.%W, under 400 keV proton irradiation over the temperature range 100–420°C. The Pd_8 W phase was observed under several combinations of irradiation dose and temperature. Post-irradiation annealing experiments involving times varying from a minimum of 5 to a maximum of 120 days, depending on the temperature, were conducted. It is concluded that Pd_8 W is thermodynamically stable at temperatures below 735°C in the 10%W alloy, but its region of stability has not been determined as a function of composition. Pd_8 W was never observed to nucleate and grow under normal isothermal annealing conditions, which underscores the crucial role played by the point defects generated during irradiation in enhancing the rate of diffusion, hence ordering. Tetragonal Pd_8 W has a very small lattice mismatch with the matrix; it is positive in the c_0-axis direction and negative in the a_0-axis direction. The lattice mismatch might play a role in a curious anomaly in the frequency of observation of the three possible orientational variants of the ordered phase. These should exist in equal proportions, but do not, the underpopulated variant being that which has its c_0 axis parallel to the incident portion beam. The mechanism responsible for this effect has not been identified. The stability of the A_8 B structure type is examined in light of crystallographic structural stability schemes recently proposed.

37207 New measurements of the elastic properties of composition modulated Cu-Ni thin films. Moreau, A. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60208 (USA)); Ketterson, J.B.; Mattson, J. *Applied Physics Letters (USA),* 56(20): 1959-1961 (14 May 1990). DOE Contract W-31109-ENG-38.

Using a new ultrasonic method which relies on the measurement of the in-phase and quadrature components of a continuous ultrasonic excitation as a function of position, we have measured the flexural modulus of composition modulated Cu-Ni self-supporting thin films. For some of the films, we have also observed the shear (S_z) modulus (allowing the calculation of the biaxial and Young's moduli). No enhancement of these moduli was observed for composition wavelengths in the range of 17–40 A.

37208 A kinetic criterion for quasi-brittle fracture. Hack, J.E. (Los Alamos National Lab., Los Alamos, NM (US)); Chen, S.P.; Srolovitz, D.J. *Acta Metallurgica (USA),* 37(7): 1957-1970 (Jul 1989).

A new criterion is proposed for quasi-brittle fracture based on the recognition that quasi-static fracture toughness measurements are merely a limiting case of dynamic fracture. It is found that a unique relationship exists between the energy stored ahead of a loaded crack or blunt notch and the velocity of a crack injected into the material by the failure of a microstructural element lying in the zone of elevated stress. The criterion establishes a minimum velocity required for the continued propagation of the injected crack as a function of the crack tip opening displacement at the instant of crack nucleation. Comparison of the predictions of the model with existing data on various steels and an aluminum alloy show excellent correlation. The implications of the model for phenomena such as the ductile-to-brittle transition, microstructural effects on the resistance to unstable crack propagation and grain boundary embrittlement/strengthening by solute segregation are also explored.

37209 Microstructure of melt spun Nd-Fe-Co-B magnets. Koestler, C. (Dept. of Materials Science, Univ. of California, Berkeley, (CA)); Ramesh, R.; Echer, C.J.; Thomas, G.; Wecker, J. *Acta Metallurgica (USA),* 37(7): 1945-1956 (Jul 1989).

In this paper the authors report results on microstructural characterization of melt spun $Nd_{17}Fe_{77}B_6$ and $Nd_{15}(Fe_{1-x}CO_x)_{77}B_8$ ribbons using high resolution electron microscopy, x-ray microanalysis and microdiffraction. In general, the microstructure consists of the hard magnetic $Nd_2Fe_{14}B$ phase and one or more grain boundary phases. In all these materials no $Nd_{1.1}Fe_4B_4$ phase was observed. The grain boundary phase in the Co-free samples appear mainly t multi-grain junctions and is a Nd-rich, crystalline (f.c.c.) phase, whereas the Co-containing specimens comprise two different f.c.c. grain boundary phases. The structural and microchemical data indicate that these are likely to be ferromagnetic and that they contain significantly less Nd than the grain boundary phase of the Co-free samples. The average matrix grain diameter is about 80 nm, but there are always some areas in every specimen where the grain diameter is very small (about 20 nm) or very large (more than 300 nm) causing differences in the size of the grain boundary phases both at the triple grain junctions and between the grains.

37210 Study of the mechanism of fast diffusion of cobalt in thorium by diffusion and internal friction measurements. Axtell, S.C. (Metallurgy Engineering Dept., South Dakota School of Mines, Rapid City, SD (US)); Carlson, O.N. *Metallurgical Transactions, A (Physical Metallurgy and Materials Science) (USA),* 20A(11): 2289-2298 (Nov 1989).

The activation energy for diffusion, Q_D, of cobalt in fcc thorium was determined to be 83.7 ± 4 kJ/mol from chemical diffusion measurements between 900°C and 1332°C. An internal friction peak associated with cobalt was identified at 45°C, and the activation energy for relaxation, Q_R, was found to be 76.0 ± 1.5 kJ/mol by a frequency variation technique. The nearly equal values for Q_D and Q_R eliminate the interstitial-vacancy pair mechanism for fast diffusion in this system. The host-solute diplon and substitutional-interstitial (S-I) pair models for fast diffusion are considered and preference is given to the latter mechanism for cobalt in thorium.

37211 Dependence of H^- production upon the work function of a Mo surface in a cesiated hydrogen discharge. Wada, M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 (USA)); Pyle, R.V.; Stearns, J.W. *Journal of Applied Physics (USA),* 67(10): 6334-6339 (15 May 1990). DOE Contract AC03-76SF00098.

The photoelectric work function of a cesiated molybdenum converter surface in a cesiated hydrogen discharge and the negative-hydrogen-ion (H^-) current produced at the surface were simultaneously measured. With the negative bias potential of the converter constant, the H^- yield increased exponentially as the work function was decreased by introducing Cs into the discharge. The yield of H^- current was always higher for a higher bias potential on the surface, provided the measured surface work function

was nearly the same. When the concentration of Cs in a discharge was nearly constant, the bias potential of the surface at which the H^- production became maximum was observed. At this bias potential, the surface work function was close to the work-function minimum.

37212 Lorentz electron microscopy of iron-rare-earth-boron sintered permanent magnets. Ramesh, R. (Department of Materials Science, University of California, Berkeley, CA (USA)); Thomas, G. *Journal of Applied Physics (USA)*, 67(11): 6968-6975 (1 Jun 1990). DOE Contract AC03-76SF00098.

The interaction of domain walls with microstructural features in sintered Fe-Nd-B magnets has been investigated by Lorentz microscopy using a high-voltage transmission electron microscope. Grain boundaries that are normal to the wall do not affect the progress of a moving wall, while those that are parallel to the wall interact strongly. The effect of the grain boundary Nd-rich fcc phase on the movement of the wall appears to depend upon the thickness of the fcc phase. Inclusions inside the matrix phase that are within 1000 A interact with the walls to pin them, while larger inclusions do not. It is suggested that a uniform distribution of inclusions with magnetic properties very different from that of the 2-14-1 phase be used to pin domain walls in order to improve the temperature dependence of the intrinsic coercivity and remanence.

37213 Evidence for cluster sites on catalytic alumina. Datta, A. (Alchemie Research Centre, Thane (India)). *Journal of Physical Chemistry (USA)*, 93(20): 7053-7054 (5 Oct 1989).

The nature of surface sites created on catalytic alumina through dehydroxylation has been investigation by TGA, FTIR, and XPS studies. There appears to be evidence for the formation at high temperatures of cluster sites which involve considerable redistribution of charge on the aluminum and oxygen atoms.

37214 High-energy metal to ligand charge-transfer states in ruthenium-diimine complexes. Myrick, M.L. (New Mexico State Univ., Las Cruces (USA)); De Armond, M.K. *Journal of Physical Chemistry (USA)*, 93(20): 7099-7107 (5 Oct 1989).

Earlier emission and absorption contours for the $[Ru(bpy)_2(dppe)]^{2+}$ complex were anomalous. In addition, the photoselection spectra (emission and excitation) differ from that found previously for $(bpy)_2$ complexes. Speculation was that these differences result from the high-energy metal to ligand charge-transfer (MLCT) state in this complex. Consequently, a number of bis Ru(II) chelate complexes with varying energy MLCT states were examined to rationalize these experimental results. The results with use of perturbation theory demonstrate an interaction between the singlet MLCT states and the π-π^* states for these materials. The correlations of the emission Stokes shift and the zero-order energy of the singlet MLCT state indicate that singlet absorption and triplet emission derive from states of different orbital configuration. Predictions of the symmetry of the absorbing singlet and emitting triplet from a simple model are consistent with the results obtained earlier from the interchromophoric coupling model.

37215 Nature of the different nickel species in sulfided bulk and alumina-supported NiMo hydrotreating catalysts. Houssenbay, S. (Universite des Sciences et Techniques de Lille-Flandres-Artois, Villeneuve d'Ascq (France)); Bonnelle, J.P.; Grimblot, J.; Kasztelan, S.; Toulhoat, H. *Journal of Physical Chemistry (USA)*, 93(20): 7176-7180 (5 Oct 1989).

Bulk nickel molybdenum sulfides have been studied by X-ray photoelectron spectroscopy (XPS) and compared to a sulfided $NiMo/\gamma\text{-}Al_2O_3$ catalyst. Several types of Ni species have been identified on both catalytic systems. A particular Ni species has been observed and assigned to Ni located at the edges of the MoS_2 slabs in a decoration position forming the so-called NiMoS phase. In bulk nickel molybdenum sulfides, ion scattering spectroscopy (ISS) and XPS results show that, for an atomic ratio Ni/(Ni + Mo) between 0.2 and 0.8, a particular surface composition exists, resulting from the existence of a phase of composition Ni/(Ni + Mo) between 0.2 and 0.3 and identified as the NiMoS phase. A comparison with the Ni-W system shows that the Ni species in decoration position is present in both the Mo- and W-based catalysts and can be assumed to be responsible for the synergy effect observed in these catalysts. On alumina, existence of this NiMoS phase has been found to be dependent on the sulfidation temperature of the oxide precursor.

37216 Frequency response method for the study of kinetics of a heterogeneous catalytic reaction of gases. Yasuda, Yusuke (Toyama Univ. (Japan)). *Journal of Physical Chemistry (USA)*, 93(20): 7184-7190 (5 Oct 1989).

A new frequency response method is proposed on the basis of actual data on $C_3H_6 + H_2 \rightarrow C_3H_8$ over Pt/Al_2O_3 at 273 K observed under each partial pressure of ca. 10 Pa: the gas space of a continuous-flow reactor was varied sinusoidally, and every partial pressure variation induced was followed by a mass spectrometer. Both amplitude and phase difference of ΔR observed in the angular frequency region from 4 to 60 rad/min were described well by ΔR $(P_H, P_H) = (R_S/P_H^{(s)})(n\Delta P_H(t) - \kappa\Delta P_H(t))$, where R_S and $P_H^{(s)}$ denote the overall reaction rate and the partial pressure of H_2 at the steady state before the oscillation and ΔP_H is the time derivative of the pressure variation, $d\Delta P_H/dt$. The rate constant n and κ were 0.15 and 7×10^{-2} min. respectively. The unordinary rate equation involving P_H was interpreted by $R = \sigma_d\mu_d$ in terms of the driving force or the free energy drop, μ_d, and the frequency factor, σ_d, at the rate-limiting step; $\Delta\sigma_d/\sigma_d = n\Delta P_H/P_H^{(s)}$ and $\Delta\mu_d/\mu_d = -\kappa\Delta P_H/P_H^{(s)}$. The newly derived rate constant κ seemed to decrease with increasing temperature. The turnover frequency could be given by n/κ.

37217 Molecular engineering: Highly ordered langmuir-blodgett films based on a cobalt phthalocyanine and its axial complexation. Palacin, S. (CEA/IRDI/DESICP/DLPC/SCM, Gif-sur-Yvette (France)); Ruaudel-Teixier, A.; Barraud, A. *Journal of Physical Chemistry (USA)*, 93(20): 7195-7199 (5 Oct 1989).

An amphiphilic cobaltous phthalocyanine, cobalt tetraoctadecyltetrapyridino [3,4-b:3′,4′-g:3″,4″-l:3‴,4‴-q]porphyrazinium bromide ($CoS_{16}Br_4$), has been synthesized. This amphiphilic macrocycle can be organized in the solid state by the Langmuir-Blodgett (LB) method, giving rise to highly ordered LB multilayers. The conjugated macrocycles lie flat on the substrate with a distribution width less than 10°. This peculiar geometry, rather unusual for phthalocyanines, is confirmed by different spectroscopic studies, in particular by anisotropic ESR measurements. This powerful technique indicates also that the cobaltous ion is axially complexed by a water molecule. Diluting the initial spreading solution of the amphiphilic macrocycle by a fatty acid gives access to an homogeneous mixed monolayer, where four fatty carboxylates have climbed onto each macrocycle. The formation of this supermolecule arises from an ion exchange within the mixed monolayer. In the same way, diluting the cobaltous phthalocyanine with an amphiphilic Lewis base such as octadecylimidazole or tricosanylamine allows in situ formation of the pentavelent complexes by axial interaction between the nitrogen doublet of the Lewis bases and the d_z2 orbital of the cobaltous ion. So, the two chemically active sites of the initial amphiphilic macrocycle can be pertinently used to build up new molecular assemblies.

37218 Infrared reflectance properties of surface thin films. Yen, Yu-Sze (Almaden Research Center, San Jose, CA (USA)); Wong, J.S. *Journal of Physical Chemistry (USA)*, 93(20): 7208-7216 (5 Oct 1989).

Analytic expressions for the reflectance of an isotropic thin film with flat, parallel sides on a semi-infinite substrate are developed for the tin film limit. Proper expressions are given for the limiting cases of ideal dielectric substrates (k_d = O) and metallic substrates ($k_b >> 1$). The interesting case of the intermediate substrate ($k_b \approx 1$) is treated for the first time. The reflectance spectra in the limiting cases are written as linear combinations of the transverse optical and longitudinal optical energy-loss functions of the thin film. Spectra of films on an intermediate substrate with constant extinction coefficient will have distorted line shapes as a result of contributions from the real part of the film's dielectric function. For a substrate with an absorption resonance, additional bands from the substrate will appear, one of which shifts in frequency with incident angle, even in a spectrum normalized to the reflectance of the bare substrate.

37219 Adsorption and electrooxidation of some simple organic molecules on rhodium(111) as probed by real-time FTIR

spectroscopy: Comparisons with platinum(111). Leung, Lam-Wing H. (Purdue Univ., West Lafayette, IN (USA)); Weaver, M.J. *Journal of Physical Chemistry (USA),* 93(20): 7218-7226 (5 Oct 1989).

The electrooxidation pathways of seven simple organic molecules in 0.1 M $HClO_4$ on ordered Rh(111) were examined by means of real-time sequences of FTIR spectra obtained during slow (2 mV s^{-1}) voltammetric sweeps. The reactants studied are formic acid, methanol, ethanol, acetaldehyde, ethylene glycol, glyoxal, and oxalic acid for concentrations between 0.05 and 0.5 M. High coverages ($\theta \geq 0.4$) of adsorbed CO are formed in most cases, as detected from a band at about 1880-1890 cm^{-1} at the most negative potentials (−0.25 to +0.05 V vs SCE), which is replaced by a band at 2030-2040 cm^{-1} at more positive potentials. These two features are assigned to C-O vibrations, ν_{CO}, associated with CO adsorbed in bridging and terminal coordination geometries, respectively. The former configuration is apparently engendered by hydrogen coadsorption. For cyclic voltammograms between −0.25 and +0.6 V, the adsorbed CO formed by dissociative reactant chemisorption only undergoes complete electrooxidation during the reverse portion of the potential sweep, at ca. 0.4V. This inability to remove adsorbed CO on ordered Rh(111) appears to be at least partly responsible for the observed weakly electrocatalytic properties of this surface for organic electrooxidations. The production of CO_2 even from formic acid, which occurs readily on Pt(111), does not commence in earnest on Rh(111) until CO is removed during the reverse scan. The electrooxidation of the other reactants on ordered Rh(111) is largely limited to the production of small amounts of CO_2, although some electrooxidation of acetaldehyde (but not ethanol) to acetic acid is detected. These results are compared with corresponding reactions on ordered Pt(111) and for the electrooxidation of solution CO.

37220 Frequency mixing in de Haas–van Alphen oscillations in heavy-fermion compounds. Sollie, R. (Department of Physics, Temple University, Philadelphia, Pennsylvania 19122 (USA)); Schlottmann, P. *Physical Review, B: Condensed Matter (USA),* 41(13): 8860-8865 (1 May 1990). DOE Contract FG02-87ER45333.

By means of a simple model calculation we estimate the amplitudes of nonlinear de Haas–van Alphen oscillations in heavy-fermion compounds, i.e., oscillations that correspond to linear combinations of ordinary closed orbits of the Fermi surface. Two possible many-body mechanisms are discussed: (i) frequency mixing via the nonlinear field dependence of the magnetization (Shoenberg effect), and (ii) the modulation of the antiferromagnetic order parameter. The incipient antiferromagnetic order in many heavy-fermion compounds at low T provides a nonlinear coupling mechanism that may lead to cross-sectional areas corresponding to differences of ordinary extremal closed orbits of the Fermi surface.

37221 Determination of the valence of Pr, Gd, and Ho in $YBa_2Cu_3O_7$ by x-ray absorption spectroscopy. Lytle, F.W. (The Boeing Company, Seattle, Washington 98124 (USA)); van der Laan, G.; Greegor, R.B.; Larson, E.M.; Violet, C.E.; Wong, J. *Physical Review, B: Condensed Matter (USA),* 41(13): 8955-8963 (1 May 1990). DOE Contract W-7405-ENG-48.

The $L_{1,2,3}$ edges of Pr, Gd, and Ho in $YBa_2Cu_3O_7$ were compared with a variety of reference compounds in an attempt to determine their valence and electronic configuration. A double-differential data analysis technique was used to resolve the multiplet structure of the $L_{1,2,3}$ edge resonances. Features were observed in the spectra that were specific for each valence. The results showed that Gd and Ho were trivalent while the spectra of Pr in Y-Ba-Cu-O were unique. The most intense $L_{2,3}$ edge resonances were at the same energy position and nearly the same in appearance as the trivalent Pr reference compounds but with unique, extra features attributable to Pr^{4+}. Their intensity was inversely proportional to Pr concentration. We tentatively identified this structure as substitution of Pr^{4+} into the Cu_2 site. These resonances may have important implications for understanding the electronic structure of Pr in Y-Ba-Cu-O and the effect on superconductivity.

37222 Magnetic excitations in USn_3. Loewenhaupt, M. (Institut fuer Festkoerperforschung, Kernforschungsanlage Juelich, Postfach 1913, D-5170 Juelich, Federal Republic of Germany (DE)); Loong, C. *Physical Review, B: Condensed Matter (USA),* 41(13): 9294-9300 (1 May 1990). DOE Contract W-31109-ENG-38.

We report on inelastic-neutron-scattering studies of the paramagnetic response in polycrystalline samples of the heavy-electron compound USn_3. The magnetic scattering function, $S(Q,E)$, was determined over a wide range of momentum and energy transfer, $0.5<Q<6$ A $^{-1}$ and $0<E<200$ meV, at temperatures ranging from 1.5 to 300 K. We find that $S(Q,E)$ at $E>2$ meV consists of only a broad quasielastic component characteristic relaxational dynamics of the U spins. The temperature dependence of the line width of this quasielastic peak exhibits a $T^{1/2}$-type power law with a large residual width at the lowest temperature. At $E<2$ meV, on the other hand, there is evidence of an additional narrow component with a full width at half maximum of the order of 1 meV. Within experimental precision, we find no evidence of other inelastic peaks due to crystal-field excitations. The single-site magnetic susceptibility, $\chi(Q,T)$, obtained by a Kramers-Kronig analysis of the quasielastic spectra, is smaller than the bulk static susceptibility at low temperatures. At a given temperature, $\chi(Q)$ exhibits a Q dependence indicative of an instability towards antiferromagnetic ordering. The experimental results are compared with the spin dynamics observed in other heavy-f-electron compounds and the implication of s-f electronic hybridization is discussed.

37223 Elucidation of the specific-heat anomaly below T_N in $NpIr_2$. Stewart, G.R. (Department of Physics, University of Florida, Gainesville, Florida 32611 (USA)); Andraka, B.; Kim, J.S.; Haire, R.G. *Physical Review, B: Condensed Matter (USA),* 41(13): 9336-9339 (1 May 1990). DOE Contract FG05-86ER45268.

The remarkable discontinuous change in the slope of the specific heat, with a resultant $\gamma>400$ mJ/mol K^2 as $T\rightarrow 0$, previously observed in the antiferromagnet $NpIr_2$, $T_N=6.7$ K, has been investigated. The specific heat of a single-phase sample of $NpIr_2$ in applied fields of 0, 5.5, and 11 T is reported along with the zero-field specific heat of NpIrOs, which has no magnetic transition in the specific heat down to the lowest temperature of measurement, 1.7 K. Instead, NpIrOs appears to be a new spin fluctuation system, $\gamma=376$ mJ/mol K^2. Using the specific heat of NpIrOs as representing the nonmagnetic background contribution in $NpIr_2$ appears to explain the sharp kink in C of $NpIr_2$ below T_N without having to invoke the existence of a third-order phase transition. Implications for spin fluctuations in magnetically ordered $NpIr_2$ are discussed.

37224 Calculation of magnetic impurities in a nonmagnetic host: Fe in Au. Weinberger, P. (Institut fuer Technische Elektrochemie, Technical University of Vienna, Vienna, Austria (AT)); Banhart, J.; Schadler, G.H.; Boring, A.M. *Physical Review, B: Condensed Matter (USA),* 41(13): 9444-9451 (1 May 1990).

The fully relativistic spin-polarized embedded-cluster method is discussed for magnetic impurities in nonmagnetic host metals. We apply the method to the calculation of the density of states and the magnetic energy of the cases of a single Fe impurity in Au, and of a pair of Fe atoms located within a first-neighbor shell cluster in Au. In addition to allowing for different distances between the two Fe impurities, we also allow for different spin orientations, with respect to the lattice symmetry of the host. We have also analyzed the spin polarization induced on a central Au site by the Fe atom(s). Thus, we have shown that the method is appropriate to obtain effective spin Hamiltonians for local moment systems, which contain local anisotropy terms and anisotropic exchange interactions.

3602 Ceramics, Cermets, and Refractories

Refer also to citation(s) 36846, 37156, 37179, 37191, 37192, 37281, 37290, 37301, 37307, 37332, 37412, 37420, 37467, 37985, 38095, 38103, 38216, 38272, 38273

37225 (CONF-900466–61) **Mechanical properties of coatings and interfaces.** Fabes, B.D. (Arizona Univ., Tucson, AZ (USA). Dept. of Materials Science and Engineering); Oliver, W.C. Oak Ridge National Lab., TN (USA); Oak Ridge Associated Universities, Inc., TN (USA). [1990]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400 ;AC05-76OR00033.

From Spring meeting of the Materials Research Society; San Francisco, CA (USA); 16-21 Apr 1990. Order Number DE90012726. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Silica Coatings of various thickness, hardnesses, and interface integrities were deposited on sapphire substrates using sol-gel techniques. The mechanical properties of the coatings were examined using a mechanical properties microprobe. The observed changes in hardness with indentation depth are explained on the basis of a model of the indentation sequence, in which three separate stages of the indentation process are described. In the first stage, the properties of the coating alone are probed: in the second stage, as the plastic field associated with the indenter extends beyond the coating into the substrate, the properties of the substrate begin to appear; and in the third stage, where the indenter penetrates into the substrate, the composite hardness is dominated by that of the substrate, although the properties of the coating are still apparent. 10 refs., 7 figs.

37226 (CONF-900466–62) **Mechanical properties of silica coatings.** Cornett, K.D. (Arizona Univ., Tucson, AZ (USA). Dept. of Materials Science and Engineering); Fabes, B.D.; Oliver, W.C. Oak Ridge National Lab., TN (USA); Oak Ridge Associated Universities, Inc., TN (USA). [1990]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400 ;AC05-76OR00033. From Spring meeting of the Materials Research Society; San Francisco, CA (USA); 16-21 Apr 1990. Order Number DE90012721. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Silica coatings with as-deposited densities ranging from approximately 50-100% were deposited on sapphire substrates by electron beam evaporation and sol-gel techniques. The shrinkage, hardness, and etch rates of the coatings were measured after various heat treatments. Differences in shrinkage indicated that hardness was not controlled by bulk porosity alone. Most films exhibited a surface "crust" that was significantly harder, and etched more slowly than the interior of the sample. We propose that the differences in mechanical and chemical behavior are caused by Si-O network reorganization starting at the film/air interface. 11 refs., 5 figs.

37227 (CONF-900801–9) **Materials research issues in superconducting levitation and suspension as applied to magnetic bearings.** Moon, F.C. (Cornell Univ., Ithaca, NY (USA). Dept. of Mechanical and Aerospace Engineering); Hull, J.R. Argonne National Lab., IL (USA). [1990]. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract W-31109-ENG-38. From 25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990. Order Number DE90011147. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Current research issues associated with the improvement of high-temperature superconductor materials for magnetic-bearing applications are discussed. Major parameters of interest include magnetic pressure, magnetic stiffness, and damping. The understanding of and improvement in magnetic flux pinning within individual grains are seen as key to large improvements in the major parameters. The necessary material properties and routes to achieving those properties differ for those applications that require minimization of rotational losses versus those that require large magnetic pressures. Increased attention to characterization of the superconducting materials in terms of the bearing performance properties is desired, and chemical stability and mechanical strength of superconducting grains within a support matrix are recognized as vital success of commercial applications. 46 refs., 4 figs.

37228 (CONF-900806–5) **Large, orientation-dependent enhancements of critical currents in $Y_1Ba_2Cu_3O_{7-x}$ epitaxial thin films: Evidence for intrinsic flux pinning?.** Christen, D.K. (Oak Ridge National Lab., TN (USA)); Klabunde, C.E.; Feenstra, R.; Lowndes, D.H.; Norton, D.; Budai, J.D.; Kerchner, H.R.; Boatner, L.A.; Thompson, J.R.; Narayan, J. Oak Ridge National Lab., TN (USA). [1990]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 19. international conference on low temperature physics; Brighton (UK); 16-22 Aug 1990. Order Number DE90009424. Available from NTIS, PC A02/MF A01 - OSTI.

The basal plane transport critical current density J_c of YBCO epitaxial thin films is strongly anisotropic, leading to large enhancements of J_c when H is precisely parallel to the copper-oxygen planes. Experimental evidence shows that the enhancement is a bulk phenomenon, and the orientation dependence is compared with a model of "intrinsic flux pinning" by the layered crystal structure. 7 refs., 2 figs.

37229 (CONF-900837–2) **Determination of the stress distributions in a ceramic: Tensile specimen using numerical techniques.** Jenkins, M.G. (Oak Ridge National Lab., TN (USA)); Ferber, M.K.; Tennery, V.J.; Salem, J.A. Oak Ridge National Lab., TN (USA). [1990]. 8p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From ASME international conference on computers in engineering; Boston, MA (USA); 5-9 Aug 1990. Order Number DE90010499. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Finite element analyses (FEA) were used to determine the stress distributions in a ceramic, tensile specimen with two types of button-head gripping systems. The FEA revealed stress raisers at both the button-head and the transition from the gage section to the shank. However, the stress field within the bulk of the gage section is uniform and uniaxial. The stress ratio, k_t, between the button-head and gage section stresses varied from 0.35 to 0.72 for the tapered collet or the straight collet systems,respectively. Previous empirical tests confirm these results whereby, the tapered collet system, compared to the straight collet system, sustained over twice the average load before failure at the button-head. 33 refs., 14 figs.

37230 (DOE/NASA/21749–1) **Assessment of fundamental materials needs for thick thermal barrier coatings (TTBC's) for truck diesel engines.** Miller, R.A. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. May 1990. 52p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AI05-88OR21749. (NASA-TM–103130). Order Number DE90011261. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The present state of development of thick thermal barrier coatings for truck diesel engines is assessed and areas where improved fundamental understanding is needed to properly pursue development are identified. Emphasis is given to the coating systems and design approaches that are being developed for the next generation of truck diesel engines under DOE/NASA support. It is noted that, while considerable progress has been made, the current level of understanding of coating system behavior is inadequate and this lack of fundamental understanding may impede current and future development. Several areas where improved understanding would be especially valuable are identified and recommendations for research into those areas are offered. 106 refs., 12 figs., 1 tab.

37231 (EGG-M–89513) **Real-time monitoring of ceramic sintering with laser ultrasonics.** Telschow, K.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 8p. Sponsored by U.S. DOE Nuclear Energy; U.S. Department of the Interior. DOE Contract AC07-76ID01570. Contract J0134035. (CONF-9006209–1: 4. international symposium on nondestructive characterization of materials, Anapolis, MD (USA), 11-14 Jun 1990). Order Number DE90012960. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A Fabry-Perot Doppler interferometer that directly measures elastic waves from rough, optically diffuse, surfaces of materials has been constructed at the Idaho National Engineering Laboratory (INEL). This apparatus, coupled with a pulsed laser for elastic wave generation, is currently being used for real-time monitoring of the sintering of zinc oxide. From the ultrasonic propagation measurements, actual densities and shrinkage values can be calculated as the material sinters; the algorithm requires previous knowledge of the ultrasonic velocity dependence on density and assumptions concerning the method of shrinkage in the material. 7 refs., 5 figs.

37232 (EGG-M–89514) **Laser ultrasonic measurements on ceramic materials with rough surfaces.** Walter, J.B.; Telschow, K.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 5p. Sponsored by U.S. DOE Nuclear Energy; U.S. Department of the Interior. DOE Contract AC07-76ID01570. Contract J0134035.

(CONF-900736–1: Conference on nondestructive evaluation of modern ceramics, Columbus, OH (USA), 9-12 Jul 1990). Order Number DE90012961. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

At the Idaho National Engineering Laboratory, noncontacting ultrasonic measurements are being made on materials while they are being processed at elevated temperatures. These materials have rough surfaces, typical of those encountered during processing. A pulsed laser is used for generation of elastic waves and a laser Doppler interferometer for detection. Processes being studied are the fabrication of silicon carbide fiber reinforced silicon carbide (SiC–SiC) by chemical vapor infiltration (CVI) and the sintering of zinc oxide (ZnO). For SiC-SiC produced by CVI, the velocity and wave amplitude of elastic waves propagating through the sample have been found to depend on the porosity and on the fiber-matrix interface bond strength. Surface waves on this material are affected by the density of the near surface layer, which can be substantially greater than that of the interior for many CVI processes. Data are also presented for the sintering of ZnO, where the laser ultrasonic method is used to monitor density and shrinkage in real time. 3 refs., 7 figs.

37233 (EGG-M–90175) **NDE [nondestructive evaluation] of critical currents in high T_c superconductors.** Telschow, K.L.; O'Brien, T.K. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC07-76ID01570. (CONF-9005183–2: 8. symposium on energy engineering sciences, Argonne, IL (USA), 9-11 May 1990). Order Number DE90012953. Available from NTIS, PC A02/MF A01 - OSTI.

The use of an electromagnetic probe as a nondestructive evaluation tool for determining critical current dissipation in high $T_c$superconducting materials is described. The probe inductively generates a current in the superconductor that adds to the externally produced transport current. Dissipation is detected in the probe response whenever the net current in the material exceeds the critical value at the location of the probe. Results are presented for a simultaneous measurement of critical current dissipation with the contact 4-point probe DC method and the noncontacting inductive method described. Interpretation of the probe response is given in terms of the homogeneous isotropic London model. 20 refs., 3 figs.

37234 (GKSS–86/E/48) **TEM investigations of the neutron irradiation behaviour of boron carbides.** Nielsen, I. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.); Hamburg Univ. (Germany, F.R.). Fachbereich Geowissenschaften. 1986. 141p. (In German). Order Number DE90501286. Available from NTIS (US Sales Only), PC A07/MF A01.

The defect structure of neutron irradiated boron carbide from a control rod of a BWR was investigated using TEM. The material was irradiated for 8 years at temperatures of 300-350deg C and showed at maximum ^{10}B-burnup of 56% a swelling of 16%. Under diffraction contrast conditions granulated or elongated contrast is observed depending on orientation and the operating reflection, which is associated with helium bubbles with diameters of 1-2 nm and number densities of 5.10^{18}-$10^{19}/cm^3$. The high swelling is caused mainly by microcracks and the small bubbles. (orig.) With 40 figs., 7 tabs.

37235 (IS-T–1437) **Selective electrocatalysis of anodic oxygen-transfer reactions at chemically modified, thin-film lead dioxide electrodes.** Chang, Hsiangpin. Ames Lab., IA (USA). Jan 1990. 60p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90011747. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The strategy to modify PbO_2 electrodes for electrocatalysis of oxygen-transfer (O-t) reactions is to incorporate spatially separated catalytic sites into the PbO_2 surface. The rate of OH radical formation is promoted at these sites, as is the rate of the O-t reaction, for the latter was demonstrated to be proportional to the former. Chemically modified PbO_2 is electrodeposited by addition of Bi^{3+}, As(III), or Cl^- to the Pb^{2+} plating bath. The electrochemical stability and catalytic activity of the Bi-doped PbO_2 (Bi-PbO_2) increase with increased Bi/Pb atomic ratio in the mixed oxide which were determined with x-ray photoelectron spectroscopy. Microcracked, ultra-thin films of Bi-PbO_2 were found at Au, Pt, GC, and Ti electrodes after consecutive deposition and stripping of the thick oxide films. The surface of pure PbO_2 can be modified by Bi^{3+}, As(V), and Cl^- by electroadsorption. The adsorption method to modify PbO_2 is fast and efficient for screening new catalysts. An O-t mediation mechanism was proposed for the electrocatalysis observed at the chemically modified PbO_2. 31 refs., 12 figs.

37236 (KAPL–4715) **Copper(II) oxide solubility behavior in aqueous sodium phosphate solutions at elevated temperatures.** Ziemniak, S.E.; Jones, M.E.; Combs, K.E.S. Knolls Atomic Power Lab., Schenectady, NY (USA). Feb 1990. 31p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC12-76SN00052. Order Number DE90011785. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A platinum-lined, flowing autoclave facility is used to investigate the solubility behavior of copper(II) oxide (CuO) in aqueous sodium phosphate solutions at temperatures between 292 and 535 K. Copper solubilities are observed to increase continuously with temperature and phosphate concentration. The measured solubility is examined via a Cu(II) ion hydrolysis/complexing model and thermodynamic functions for the hydrolysis/complexing reactions are obtained from a least- squares analysis of the data. Altogether, thermochemical properties are established for five anionic complexes: $Cu(OH)_3^-$, $Cu(OH)_4^{=}$, $Cu(OH)_2(HPO_4)^{=}$, $Cu(OH)_3(H_2PO_4)^{=}$, and $Cu(OH)_2(PO_4)^{\equiv}$. Precise thermochemical parameters are also derived for the $Cu(OH)^+$ hydroxocomplex based on CuO solubility behavior previously observed in pure water (*) at elevated temperatures. The relative ease of Cu(II) ion hydrolysis is such that $Cu(OH)_3^-$ species become the preferred hydroxocomplex for pH $\geq$ 9.4. 20 refs., 8 figs., 6 tabs.

37237 (ORNL/Sub–84-00214/1) **Synthesis of high purity sinterable silicon carbide powder: Final report.** Boecker, W.D. (Carborundum Co., Niagara Falls, NY (USA). Structural Ceramics Div.); Mehosky, B.L.; Rogers, R.S.C.; Storm, R.S.; Venkateswaran, V. Oak Ridge National Lab., TN (USA); Carborundum Co., Niagara Falls, NY (USA). Structural Ceramics Div. Nov 1989. 277p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE90012029. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

High purity, submicron silicon carbide powders were produced via gas phase synthesis using a hydrogen/argon plasma. Two test facilities were constructed, a bench-scale unit and a larger pilot scale reactor. Three candidate silicon sources were evaluated:silicon tetrachloride ($SiCl_4$). dimethyldichlorosilane ($(CH_3)_2(SiCl_2)$ and methyltrichlorosilane (CH_3SiCl_3). Product powders were evaluated on the basis of pressureless sinterability, surface area, agglomeration, particle size distribution, phase distribution and chemistry. Three commercial powders, Starck A10, Starck B10, and Carborundum submicron alpha silicon carbide, were also evaluated for comparison to the product powders. Powders were reproducibly synthesized at a rate of one pound per hour for standard run times of five hours. Product powders exhibited chemical and physical properties equal to or exceeding the commercial powders evaluated. In limited attempts to pressureless sinter the product powders, densities of 91% of theoretical were obtained with as-produced powder. Post-processing permitted densities in excess of 97% of theoretical. X-ray diffraction of the product indicates that the product powders are primarily beta polytypes, with traces of alpha present. Increased production rates to a target level of seven pounds per hour were not possible due to current transients produced by the pilot scale power supply. Extensive unsuccessful efforts to reduce or eliminate the transients are described. Low recovered product yields resulted from a failure of a product collection filter that was not discovered until the completion of the project.

37238 (SAND–89-2802C) **Sol-gel coating on acoustic wave devices: Thin film characterization and chemical sensor development.** Frye, G.G.; Brinker, C.J.; Ricco, A.J.; martin, S.J.; Hilliard, J.; Doughty, D.H. Sandia National Labs., Albuquerque, NM (USA). [1990]. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900466–56: Spring

meeting of the Materials Research Society, San Francisco, CA (USA), 16-21 Apr 1990). Order Number DE90012224. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have investigated the use of porous oxide coatings, formed using sol-gel chemistry routes, as the discriminating elements of acoustic wave (AW) chemical sensors. These coatings provide several unique advantages: durability, high adsorption capacity based on large surface areas, and chemical selectivity based on both molecular size and chemical interactions. The porosity of these coatings is determined by performing nitrogen adsorption isotherms using the AW device response to mass changes to monitor the uptake of nitrogen at 77 K. These studies demonstrate how sol-gel chemistry and film-forming technique can be used to tailor the microstructure of thin coatings. The chemical sensitivity and selectivity obtained with this class of coatings will be demonstrated using several examples: hydrous titanate ion exchange coatings, zeolite/silicate microcomposite coatings, and surface-modified silicate films. 18 refs., 4 figs., 2 tabs.

37239 (SAND–89-2860C) **Laser techniques for studying chemical vapor deposition.** Ho, P.; Breiland, W.G.; Coltrin, M.E. Sandia National Labs., Albuquerque, NM (USA). [1990]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. (CONF-900656–2: Meeting on optical spectroscopic instrumentation and techniques for the 1990s: applications in astronomy, chemistry and physics, Las Cruces, NM (USA), 4-6 Jun 1990). Order Number DE90012921. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Chemical vapor deposition (CVD) is widely used to produce thin films for microelectronics, protective coatings and other materials processing applications. Despite the large number of applications, however, little is known about the fundamental chemistry and physics of most CVD processes. CVD recipes have generally been determined empirically, but as process requirements become more stringent, a more basic understanding will be needed to improve reactor design and speed process optimization. In situ measurements of the reacting gas are important steps toward gaining such an understanding, both from the standpoint of characterizing the reactor and testing models of a CVD process. Our work, a coordinated program of experimental and theoretical research in the fundamental mechanisms of CVD, illustrates the application of laser techniques to the understanding of a CVD system. We have used a number of laser-based techniques to probe CVD systems and have compared our measurements with predictions from computer models, primarily for the silane CVD system. The silane CVD model solves the two-dimensional, steady-state boundary layer equations of fluid flow coupled to 26 elementary chemical reactions describing the thermal decomposition of silane and the subsequent reactions of intermediate species that result in the deposition of a silicon film.

37240 (SAND–89-3088C) **The effects of hydrolysis and additive conditions on the gel-to-ceramic conversion of sol-gel derived $PbTiO_3$.** Schwartz, R.W. (Illinois Univ., Urbana, IL (USA). Materials Research Lab.); Lakeman, C.D.E.; Payne, D.A. Sandia National Labs., Albuquerque, NM (USA). [1990]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900466–66: Spring meeting of the Materials Research Society, San Francisco, CA (USA), 16-21 Apr 1990). Order Number DE90012999. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Lead titanate was prepared by sol-gel processing of metal alkoxide solutions. The effects of hydrolysis level (i.e., moles H_2O/mole $PbTiO_3$) and acid and base additives (HNO_3 or NH_4OH) on desiccated gel properties and the gel-to-ceramic conversion process were studied. The properties of the gels were characterized at three stages of the processing cycle: (1) the desiccated gel state; (2) the amorphous state, following organic pyrolysis; and (3) the crystalline state. Differences in the physical and structural properties of the desiccated gels, induced through manipulation of the hydrolysis conditions, persisted in the amorphous state, i.e,. following organic pyrolysis. Minor differences remained after crystallization. The variation in material properties with low temperature processing (i.e., the gel-to-glass transformation) is considered from the standpoint of the effects of hydrolysis and additive conditions on gel network structure and consolidation behavior. The densification and crystallization behavior of the gels were also characterized. Through proper control of hydrolysis conditions, relatively dense ceramics were obtained at temperatures as low as 700°C.

37241 (SAND–90-1314C) **Wear mechanisms of amorphous carbon and zirconia coatings on rigid disk magnetic recording media.** Dugger, M.T. (Northwestern Univ., Evanston, IL (USA)); Chung, Y.W.; Bhushan, B.; Rothschild, W. Sandia National Labs., Albuquerque, NM (USA). [1990]. 33p. DOE Contract AC04-76DP00789. (CONF-901071–4: Joint STLE-ASME tribology conference, Toronto (Canada), 7-10 Oct 1990). Order Number DE90011053. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Examination of the durability of zirconia-coated rigid disks in various environments reveals a sensitivity to the presence of water vapor during sliding. Vacuum and dry air yield contact durabilities of 300 to 400 m, while in 50% relative humidity air the contact life increases to about 20 km. The durability of amorphous carbon-coated disks was also found to be more sensitive to the presence of moisture than to oxygen. The dominant factors affecting wear are believed to be oxidation of metallic debris and interaction of the overcoat layer with water vapor. Tests with ferrite read/write sliders on carbon-coated disks suggest that the pin-on-disc test is a valid simulation of the tribological behavior of this system. Carbon film thickness measurements indicate that the carbon film remains intact without appreciable thinning until the point of failure. 25 refs., 12 figs., 1 tab.

37242 (SAND–90-1670C) **Superconducting La_2CuO_{4+x} prepared by oxygenation at high pressure: A Raman scattering study.** McCarty, K.F. (Sandia National Labs., Albuquerque, NM (USA)); Schirber, J.E.; Cheong, S.W.; Fisk, Z. Sandia National Labs., Albuquerque, NM (USA). [1990]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789 ;W-7405-ENG-36. (CONF-9007114–1: SPIE conference on Raman and luminescence spectroscopies in technology, San Diego, CA (USA), 10-12 Jul 1990). Order Number DE90012915. Available from NTIS, PC A03/MF A01 - OSTI.

Superconducting crystals of La_2CuO_{4+x} prepared by high-pressure oxygenation have been analyzed by Raman spectroscopy. A direct comparison of the role of excess oxygen was made by examining the same crystals with and without excess oxygen. La_2CuO_{4+x}, like non-superconducting $La_2CuO_{4.0}$, is found to have a soft phonon that drives an orthorhombic to tetraganol phase transition. In both its tetraganol and orthorhombic forms, La_2CuO_{4+x} has a phonon peak at 630 cm^{-1} that is absent in $La_2CuO_{4.0}$. The frequency of this peak is suggestive of a peroxide-like species in La_2CuO_{4+x} occur at essentially the same frequency. While $La_2CuO_{4.0}$ has a well-defined peak from double-magnon scattering, no well-defined double-magnon scattering is observed in La_2CuO_{4+x}, even in its phase separated form. 13 refs., 6 figs., 2 tabs.

37243 (UCRL–102154) **Densification studies of refractory materials using Hot Isostatic Pressing (HIP) and tantalum containment.** Hoenig, C.; Otto, R.; Stutler, W. Lawrence Livermore National Lab., CA (USA). 27 Apr 1990. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-900634–2: 7. world ceramics congress: ceramics today–tomorrow's ceramics, Montecatini Terme (Italy), 24-30 Jun 1990). Order Number DE90013481. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Powders of crystalline rohmbohedral boron were HIP processed to near full density at 1500-1800°C and 206.8 MPa. At 1700°C, the densification of boron was independent of particle size in the range of <37 μm to 10 mm. At 1500°C, only the <37-μm powder reached near full density. Silicon and calcium impurities were found to segregate in the grain boundaries during densification. Results indicate that plastic yielding was to dominate densification mechanism. Boron nitride powder with 0.97% oxygen content was pressed to a density of 2.21 g/cm^3 at 18000°C and 206.8 MPa. The density of high-purity hot-pressed graphite was increased by 15% to 2.10 g/cm^3 at 2200°C and 206.8 MPa. These results show that refractory metal containers used in hot isostatic pressing significantly expand the availability of high-density-high purity materials. 3 refs., 7 figs., 2 tabs.

37244 (UCRL–102546) **Design and fabrication of high damage threshold turning mirrors for the Nova laser.** Wolfe, C.R. (Lawrence Livermore National Lab., CA (USA)); Kozlowski, M.R.; Marchi, F.T.; Rainer, F.; Enemark, E. Lawrence Livermore National Lab., CA (USA). [1990]. 26p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-900756–6: SPIE's international symposium on optical and optoelectronic applied science and engineering and exhibit, San Diego, CA (USA), 8-13 Jul 1990). Order Number DE90012703. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Laser induced damage to optical components severely limits the operating fluence of high peak power lasers used for fusion research such as the Nova laser at the Lawrence Livermore National Laboratory. In particular, surfaces and optical thin films often damage at a lower fluence than bulk materials in large aperture, high quality optics. We have designed and are fabricating new 94 cm turning mirrors for Nova as part of the "Precision Nova" program to improve beam quality. A new design has been optimized for updated optical performance specifications including increased damage resistance. The new mirror design will operate at all turning angles required by the ten Nova beamlines. This flexibility reduces mirror inventory and fabrication cost. A process of "conditioning" the mirror coating has been developed that is permanent and increases the damage threshold by as much as a factor of 2–3x. 5 refs., 14 figs., 2 tabs.

37245 High temperature superconducting compounds: Processing and related properties; Proceedings of the Symposium on High Temperature Superconducting Oxides: Processing and Related Properties, Las Vegas, NV, Feb. 27, 28, 1989. Whang, S.H.; Dasgupta, A. 701p. Minerals, Metals, and Materials Society, Warrendale, PA (US) (1989). (CONF-890216–: International symposium on high $T_c$superconducting oxides: processing and related properties, Las Vegas, NV (USA), 27-28 Feb 1989).

Recent advances in the preparation and processing of high-Tc superconductors (HTSs) are discussed in reviews and reports. Topics examined include HTS single crystals, ceramics, composites, substitution, casting and mechanical alloying, compaction, and chemical treatment; HTS films and coatings; HTS fibers, wires, tapes, ribbons, and sheets; HTS thermodynamics; physical properties; and mechanical properties. Particular attention is given to flux pinning in single-crystal $YBa_2Cu_3O(7-x)$, screening of processing variables for $YBa_2Cu_3O(x)$, the fabrication and evaluation of cermet HTSs, microstructures and intragrain critical current densities in $YBa_2(Cu/1-x/M/x/)_3O_7$, hot compaction and forming of monolithic and composite oxide HTSs, processing chemically prepared Tl-Ca-Ba-Cu oxides, plasma-spray preparation of HTS coatings, melt-spinning/oxidation of Yb-Ba-Cu-O-Ag HTSs, O-18 effects in $YBa_2Cu_3O(7-delta)$, and oxidation kinetics and microcracking in $YBa_2Cu_3O(7-x)$ ceramics.

37246 Intrinsic fast oxygen ionic conductivity in the $Gd_2(Zr_xTi_{1-x})_2O_7$ and $Y_2(Zr_xTi_{1-x})_2O_7$ pyrochlore systems. Moon, P.K. (Dept. of Materials Science and Engineering, Massachusetts Inst. of Technology, Cambridge, MA (US)); Tuller, H.L. pp. 149-163 of Solid state ionics. Nazri, G.; Huggins, R.A.; Shriver, D.F. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-8811221–: Solid state ionics, Boston, MA (USA), 28 Nov - 2 dec 1988).

The pyrochlore solid solution $Gd_2(Zr_xTi_{1-x})_2O_7$ was found to be an attractive system for investigating the relationship between composition, structural disorder and ionic conductivity. Both cation and anion order parameters were found to decrease systematically with increasing substitution of Zr for Ti leading ultimately to intrinsic fast oxygen ion conductivity in the solid solution. The degree of intrinsic disorder was determined quantitatively from doping experiments and was found to be equal to $1.0 \times 10^{39}\exp(-0.24 \pm 0.03$ eV/kT)cm^{-6} for x = 0.3 and substantially larger for higher values of x. Oxygen vacancy mobilities, on the other hand, were found to be relatively independent of x with values of $\mu_V = 0.15\exp(-0.78 \pm 0.02$eV/kT)$cm^2V^{-1}s^{-1}$. These, and more recent results, on $Y_2(Zr_xTi_{1-x})_2O_7$ are discussed in the context of the similarities between the pyrochlore and fluorite phases.

37247 Properties of electrolyte and electrode films prepared by rf and dc magnetron sputtering. Bates, J.B. (Solid State Div., Oak Ridge National Lab., Oak Ridge, TN (US)); Dudney, N.J.; Chu, Y.T.; Mazumdar, P. pp. 143-148 of Solid state ionics. Nazri, G.; Huggins, R.A.; Shriver, D.F. Materials Research Society, Pittsburgh, PA (USA) (1989). DOE Contract AC05-84OR21400. (CONF-8811221–: Solid state ionics, Boston, MA (USA), 28 Nov - 2 dec 1988).

Increased interest in ion conducting thin films and thin-film devices is discussed. Magnetically enhanced (magnetron) sputtering is an important technique for depositing these as well as other kinds of ceramic thin films. Two advantages of magnetron over conventional diode sputtering are the increased sputtering rate, which is important in the deposition of ceramic materials, and the reduction in electron bombardment of the substrate and growing film. In this paper, the authors describe high-vacuum film growth chamber and present the results of tests of this system in fabricating films of lithium ion conducting glass electrolytes, TiS_2, and vanadium oxide by reactive dc and rf magnetron sputtering. The results of combining these films into a thin film lithium battery also are discussed.

37248 Incorporation of defects during processing of mercuric iodide detectors. Bao, X.J. (Department of Electrical and Computer Engineering, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213 (USA)); Schlesinger, T.E.; James, R.B.; Stulen, R.H.; Ortale, C.; Cheng, A.Y. *Journal of Applied Physics (USA)*, 68(1): 86-92 (1 Jul 1990).

The effects of chemical etching in KI solution, heating, and vacuum exposures of HgI_2 were individually studied by low-temperature photoluminescence (PL) spectroscopy. Each of these processing steps is important in the manufacturing of mercuric iodide detectors and may be responsible for the incorporation of carrier traps both in the near-surface region and in the bulk. The results of etching experiments showed that the near-surface region has a different defect structure than the bulk, which appears to result from iodine deficiency. Bulk heating at 100 °C also modifies the defect structure of the crystal. Vacuum exposure has an effect similar to chemical etching, but it does not cause significant degradation of the stoichiometry for recently KI-etched specimens. These studies suggest that some features in the PL spectra of HgI_2 are associated with stoichiometry of the specimens.

37249 Y-Ba-Cu-O thin films grown on rigid and flexible polycrystalline yttria-stabilized zirconia by pulsed laser ablation. Norton, D.P. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831 (USA)); Lowndes, D.H.; Budai, J.D.; Christen, D.K.; Jones, E.C.; McCamy, J.W.; Ketcham, T.D.; Julien, D.S.; Lay, K.W. *Journal of Applied Physics (USA)*, 68(1): 223-227 (1 Jul 1990). DOE Contract AC05-84OR21400.

In situ growth of highly oriented $YBa_2Cu_3O_{7-x}$ thin films (200–500 nm in thickness) has been obtained by pulsed KrF (248 nm) laser ablation on both rigid and flexible randomly oriented polycrystalline yttria-stabilized zirconia substrates. It is shown that *c*-axis-perpendicular $YBa_2Cu_3O_{7-x}$ films with a mosaic spread of only 1.0° can be grown on these randomly oriented polycrystalline substrates. Superconducting thin films were obtained with $T_c(R=0)\sim89$ K on well-polished substrates. For the films deposited on the flexible substrates, the superconducting T_c is not degraded by repeated bending of the flexible substrate/film composite over a 2.25-cm-radius arc although the normal-state resistivity increases slightly, suggesting the creation of microcracks. The $YBa_2Cu_3O_{7-x}$ films grown on rigid polycrystalline yttria-stabilized zirconia substrates have a critical current density $J_c(H=0)\sim1400$ A/cm^2 at 77 K.

37250 Transport critical current density and microstructure in extruded $YBa_2Cu_3O_{7-x}$ wires processed by zone melting. Shi, D. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439 (USA)); Krishnan, H.; Hong, J.M.; Miller, D.; McGinn, P.J.; Chen, W.H.; Xu, M. *Journal of Applied Physics (USA)*, 68(1): 228-232 (1 Jul 1990). DOE Contract W-31-109-ENG-38.

$YBa_2Cu_3O_{7-x}$ compounds were extruded into long wires with the diameter of 1 mm after sintering. The sintered wires were subsequently zone melted to develop a highly textured microstructure. Magnetization experiments at 77 K indicated a J_c value of 1×10^5 A/cm^2 at 1 T. Transport measurements at 77 K showed a greatly

enhanced field dependence of the critical current density. Transmission electron microscopy revealed an important grain-boundary feature which eliminated the weak-link behavior. Large amounts of dislocations have also been found in the zone-melted sample which may contribute to flux pinning in the system.

37251 Theoretical model for deposition of superconducting thin films using pulsed laser evaporation technique. Singh, R.K. (Department of Materials Science and Engineering, North Carolina State University, Raleigh, North Carolina 27695-7916 (USA)); Holland, O.W.; Narayan, J. *Journal of Applied Physics (USA)*, 68(1): 233-247 (1 Jul 1990). DOE Contract AC05-84OR21400.

We have theoretically and experimentally analyzed the laser-induced evaporation process for deposition of superconducting thin films from bulk targets. The spatial thickness variations have been found to be significantly different from a conventional thermal deposition process. Unlike a cos θ thickness variation expected from a thermal evaporation process, the laser evaporation process is characterized by a forward-directed deposit with a sharp variation in its thickness as a function of distance from the center of the deposit. We have studied in detail the interactions of nanosecond excimer laser pulses with bulk $YBa_2Cu_3O_7$ targets leading to evaporation, plasma formation, and subsequent deposition of thin films. A theoretical model for simulating the pulsed laser evaporation (PLE) process has been developed. This model considers an anisotropic three-dimensional expansion of the laser-generated plasma, initially at high temperature and pressure. The forward-directed nature of laser deposition has been found to result from anisotropic expansion velocities of the plasma edges arising due to the density gradients in the gaseous plasma.

37252 Polarization currents in varistors. Modine, F.A. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6030 (USA)); Major, R.W.; Choi, S.I.; Bergman, L.B.; Silver, M.N. *Journal of Applied Physics (USA)*, 68(1): 339-346 (1 Jul 1990). DOE Contract AC05-84OR21400.

The time, voltage, and temperature dependencies of transient polarization currents are reported for two types of varistors (i.e., ZnO and a SiC composite). The current transients exhibit a power-law time response to a step change in voltage (i.e., $I \approx I_0/t^m$, where m is slightly less than unity) that persists over a time scale exceeding 10^{-6}–10^4 s. The polarization current increases linearly with low applied voltage, but at more than a linear rate for higher voltage. The temperature dependence of the polarization current in medium voltage ZnO varistors is described by an Arrhenius plot with a change of slope near 200 K, which suggests thermal activation energies of about 160 and 10 meV. The time dependence of the polarization currents is confirmed and extended to short times by the ac admittance measured as a function of frequency. Transient changes in the ac admittance accompany the transient polarization currents, and exhibit time and temperature dependencies that reveal their close relationship to the polarization currents. By comparing transient admittance data to predictions of the Mott–Schottky theory of a barrier, it is concluded that the theory gives an inadequate account of the ac conductance, even though the voltage dependence of the capacitance is predicted well. Theoretical explanations of the polarization currents that are based upon a distribution of exponential relaxation times are examined. A reasonable account of the polarization current is provided, but the origin of the distribution is uncertain. Possible origins are a distribution of thermal activation energies or electron hopping among randomly distributed donors.

37253 Technique for tensile creep testing of ceramics. Carroll, D.F. (Dow Chemical Co., Midland, MI (USA)); Wiederhorn, S.M.; Roberts, D.E. *Journal of the American Ceramic Society (USA)*, 79(9): 1610-1614 (Sep 1989).

An experimental technique for measuring tensile creep deformation in ceramic materials to temperatures of 1500°C is described. The technique uses simple flat dog-bone-shaped specimens and a hot-grip design for the loading fixture, which provide good alignment at minimum cost. Creep deformation is measured using laser extensometry to monitor the relative displacement of flags that are attached to the gauge section of the specimen.

37254 Characterization of the strength and microstructural evolution of a heavily cold rolled Cu-20% Nb composite. Trybus, C.L. (Ames Lab., USDOE, Iowa State Univ., Ames, IA (US)); Spitzig, W.A. *Acta Metallurgica (USA)*, 37(7): 1971-1982 (Jul 1989). DOE Contract W-7405-ENG-82.

The mechanical properties and microstructures have been evaluated for a heavily cold rolled Cu-20 vol.% Nb composite. The strength of the rolled composite dramatically increases with increasing rolling deformation up to a true strain of 6.9, the maximum investigated. Longitudinal and transverse specimens both possessed equivalent mechanical properties. The unusually high tensile strengths observed in this material are dependent upon the microstructures which develop during cold rolling. Nb elongates during deformation, and forms ribbon-like filaments that are perfectly aligned parallel to the sheet surface, that is, in two directions longitudinal and transverse, while the Cu matrix undergoes a cycle of deformation-dynamic recovery-recrystallization which allows for the further reduction of the Nb. The dislocation density of the Cu matrix is found to be on the order of $10^{10}/cm^2$ throughout the rolling process. The strengthening in rolled and wire drawn Cu-Nb correlates with the amount of deformation in a similar manner even though during wire drawing the Nb filaments curl bout the wire axis and, therefore, are aligned only in the longitudinal direction. As a consequence of the Nb morphological difference in the sheet versus the wire composite, strengthening in the sheet does not show a Hall–Petch relationship, as the wire does, but a much weaker dependence on Nb filament spacing. Strengthening in the rolled composite is in accord with a modified rule of mixtures model but this model cannot account for the observed strengthening in wire drawn Cu-Nb.

37255 Increase in the flux-pinning energy of $YBa_2Cu_3O_{7-\delta}$ by shock compaction. Weir, S.T. (Lawrence Livermore National Laboratory, University of California, P. O. Box 808, Livermore, California 94550 (USA)); Nellis, W.J.; Kramer, M.J.; Seaman, C.L.; Early, E.A.; Maple, M.B. *Applied Physics Letters (USA)*, 56(20): 2042-2044 (14 May 1990). DOE Contract W-7405-ENG-82.

Magnetic flux relaxation data on a composite specimen of $YBa_2Cu_3O_{7-\delta}$ +Ag shock compacted at 167 kbar show that the flux-pinning energy at 70 K and 10 kOe is enhanced by a factor of 2–3. This enhancement persists after annealing at 890 °C in oxygen for 24 h. The increased pinning energy is apparently caused by shock-induced ⟨100⟩ and ⟨110⟩ line defects having a density up to 10^{12} cm^{-2}. Annealing replaces line defects with (001) extrinsic stacking faults having displacement vectors of 1/6[031]. The average separation of the stacking faults in the [001] direction is 0.04 μm, which is comparable to the separation between fluxoids at 10 kOe. These results indicate that intragranular critical current densities can be increased significantly in bulk materials by shock processing. High densities of flux-pinning sites could be induced efficiently in industrial-scale quantities of bulk high T_c oxides by explosives.

37256 *In situ* processing of textured superconducting thin film of Bi(-Pb)-Ca-Sr-Cu-O by excimer laser ablation. Kumar, A. (Department of Materials Science and Engineering, North Carolina State University, Raleigh, North Carolina 27695-7916 (USA)); Ganapathi, L.; Narayan, J. *Applied Physics Letters (USA)*, 56(20): 2034-2036 (14 May 1990).

We have prepared highly oriented bismuth cuprate thin films (*c*-axis textured) on yttria-stabilized zirconia (100) YS-ZrO_2 substrates at 650 °C by pulsed excimer laser ablation in a 200 mTorr oxygen ambient. The films were annealed in oxygen and nitrogen atmospheres to study the effect on zero-resistance transition temperature (T_{c0}). Thin films deposited at 650 °C exhibited a T_{c0} of 68 K with onset at 110 K. Post-annealing for 1 h at 400 °C in oxygen improved the T_{c0} to 82 K, while the onset remained the same. X-ray diffraction, scanning electron microscopy, and Rutherford backscattering channeling studies were performed on these films for correlations between crystal structure, microstructure, and superconducting properties. X-ray diffraction patterns indicated a 2212 type phase with a=5.39 A and c=30.76 A; preferential orientation of the *c* axis perpendicular to the substrate was observed. The lattice parameters and x-ray diffraction patterns were found to be invariant with annealing treatments that improved T_{c0} from 68 to 82 K.

37257 Coarsening kinetics of the tetragonal phase in a manganesia-partially-stabilized zirconia. Bateman, C.A. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Materials Science and Engineering); Notis, M.R.; Williams, D.B. *Journal of the American Ceramic Society (USA),* 72(12): 2372-2376 (Dec 1989).

The coarsening kinetics of the tetragonal phase in a magnesia-partially-stabilized zirconia at 1420°C was examined using transmission electron microscopy and found to be controlled by volume diffusion. The rate constant was larger and the particle-size distribution was broader than predicted by the Lifshitz–Slyozov–Wagner theory of particle coarsening. A volume fraction modified coarsening theory was found which better fits the experimental rate constant and particle-size distribution.

37258 Strongly enhanced flux pinning by high-energy proton irradiation of a $Tl_2Ca_2Ba_2Cu_3O_y$ single crystal. Venturini, E.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800 (10)); Barbour, J.C.; Ginley, D.S.; Baughman, R.J.; Morosin, B. *Applied Physics Letters (USA),* 56(24): 2456-2458 (11 Jun 1990). DOE Contract AC04-76DP00789.

Flux creep data are reported which clearly demonstrate a dramatic enhancement in the pinning potential for magnetic vortices (fluxoids) in a $Tl_2Ca_2Ba_2Cu_3O_y$ single crystal upon irradiation with 4.5 MeV protons. The creep rate is markedly reduced between 5 and 80 K, and the effective pinning potential is quadrupled from ≈100 to ≈400 meV at 20 K in a field of 50 mT. This stronger pinning enhances the magnetization hysteresis and hence the inferred low-field critical current density by a factor of 5 at 40 K.

37259 Neutron-induced microwave loss in ceramic $YBa_2Cu_3O_{7-\delta}$. Cooke, D.W.; Jahan, M.S.; Brown, R.D.; Ott, K.C.; Gray, E.R.; Smith, J.L.; Willis, J.O.; Bennett, B.L.; Maez, M.A.; Peterson, E.J. *Applied Physics Letters (USA),* 56(24): 2462-2464 (11 Jun 1990). DOE Contract AC03-76SF00098.

An increase by over three orders of magnitude from 0.58 mΩ to 1.17 Ω was observed at 4.0 K in the 3 GHz microwave surface resistance of ceramic $YBa_2Cu_3O_{7-\delta}$ following exposure to neutrons. The transport resistivity of an unirradiated pellet was linear in temperature down to T_c with a room-temperature value of 2.13 mΩ cm and a resistivity extrapolated to 4.0 K of 0.53 mΩ cm. Following irradiation, the resistivity rose with decreasing temperature from a room-temperature value of 1.5 Ω cm to a maximum at around 45 K with little change evident at T_c . These results, in conjunction with eddy current, susceptibility, iodometric titration, and thermally stimulated luminescence measurements on irradiated and unirradiated samples, collectively suggest that the effect of neutron irradiation has been to decrease intergranular coupling without the development of an insulating phase.

37260 Strontium-induced oxygen defect structure and hole doping in $La_{2-x}Sr_xCuO_4$ (B). Tan, Z. (University of Connecticut, Storrs, Connecticut 06269 (USA)); Filipkowski, M.E.; Budnick, J.I.; Heller, E.K.; Brewe, D.L.; Chamberland, B.L.; Bouldin, C.E.; Woicik, J.C.; Shi, D. *Physical Review Letters (USA),* 64(22): 2715-2718 (28 May 1990). DOE Contract AS05-80ER10742 ;AC02-76CH00016 ;W-31109-ENG-38.

We have discovered that the apical oxygen with a 2.35-A La-O bond length is removed when La is substituted by Sr in polycrystalline $La_{2-x}Sr_xCuO_4$ under normal preparation conditions. This apical oxygen can be partially filled by oxygen annealing. It is reasoned that a defect oxygen is trapped at an interstitial site near the Sr atom. We present evidence that this defect oxygen is intrinsic to Sr doping, independent of processing conditions. We propose that this defect oxygen serves as a mechanism for hole doping similar to that in the superconducting oxygen-rich La_2CuO_{4+y}.

37261 Rapid thermal processing of $YBa_2Cu_3O_7$ spun wires. Ginley, D.S. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800 (USA)); Venturini, E.L.; Kwak, J.F.; Mitchell, M.A.; Morosin, B.; Baughman, R.J.; Halloran, J.W.; Neal, M.J. *Journal of Applied Physics (USA),* 67(10): 6382-6388 (15 May 1990). DOE Contract AC04-76DP00789.

Rapid thermal processing has been utilized to sinter and anneal phase-pure and CuO-rich $YBa_2Cu_3O_7$ fibers and woven fibers formed by melt spinning a powder/polymer composite. The optimum temperature for sintering the powders varies for the stoichiometric (1025 °C) and 5% CuO-rich fibers (1000 °C), but in both cases the temperature window is extremely narrow (±25 °C). Typical processing consists of a rapid heating (250 °C/s) of the fibers to the sintering temperature in 1 atm of pure oxygen, holding at temperature for 1 s and cooling over a period of 2–3 min. The resulting fibers are orthorhombic $YBa_2Cu_3O_7$ with large Meissner and shielding fractions, have zero resistance up to 92 K, critical-current densities in zero applied field to 1100 A/cm^2 at 76 K, and show clean grain boundaries by transmission electron microscopy. Despite the short processing times, microstructural analysis shows considerable grain growth and evidence of metastable congruent melting of oxygen-rich $YBa_2Cu_3O_7$.

37262 Pulse response characteristics of ZnO varistors. Modine, F.A. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6030 (USA)); Wheeler, R.B. *Journal of Applied Physics (USA),* 67(10): 6560-6566 (15 May 1990). DOE Contract AC05-84OR21400.

A study is reported of the influences of temperature, circuit resistance, and pulse repetition rate on the ZnO varistor inductive pulse response that is disclosed by voltage overshoot and current undershoot. Exponential time constants are fitted to the voltage overshoot and the current undershoot obtained by using high- and low-impedance pulse supplies, respectively. Nearly identical time constants of a few microseconds are found at room temperature, but the voltage overshoot exhibits a temperature-independent time constant whereas the current undershoot exhibits a shorter time constant at low temperature. However, it is also demonstrated that small increases in circuit resistance can change the shape of the current undershoot and cause a decrease in the calculated time constant. It is concluded that the temperature dependence of the current undershoot is a direct consequence of the temperature dependence of the grain resistivity and that it does not result from a temperature-dependent barrier response. The response to repeated pulses reveals a significant polarization current even when a varistor is in the highly conducting breakdown state. A long-term memory of preceding pulses is associated with this polarization current. The inductive response of a varistor is complicated by the influence of this memory, and a shorter-term memory attributed to the lifetime of electron holes.

37263 Phase diagram and low-temperature behavior of oxygen ordering in $YBa_2Cu_3O_z$ using *ab initio* interactions. Ceder, G. (Department of Materials Science and Mineral Engineering, University of California, Berkeley, Berkeley, CA (USA)); Asta, M.; Carter, W.C.; Kraitchman, M.; Fontaine, D. de; Mann, M.E.; Sluiter, M. *Physical Review, B: Condensed Matter (USA),* 41(13): 8698-8701 (1 May 1990). DOE Contract AC03-76SF00098.

The phase diagram and oxygen ordering in $YBa_2Cu_3O_z$ are investigated, on a first-principles basis, by means of an asymmetric next-nearest-neighbor Ising model using Monte Carlo and cluster-variation-method statistics. It is shown that saturation of some pair-correlation functions at low temperature to a concentration-independent value makes the model quasi-one-dimensional. This correspondence between the two- and one-dimensional model explains some typical characteristics of the phase diagram at low temperature and provides a simple argument for the existence of a low-temperature, low-O-concentration, orthorhombic phase.

37264 Superconductivity under high pressure of $YBa_2(Cu_{1-xM_x})_3O_{7-\delta}$ (*M*=Fe, Co, Al, Cr, Ni, and Zn). Huber, J.G. (Physics Department, Virginia Commonwealth University, Richmond, Virginia 23284 (USA)); Liverman, W.J.; Xu, Y.; Moodenbaugh, A.R. *Physical Review, B: Condensed Matter (USA),* 41(13): 8757-8761 (1 May 1990). DOE Contract AC02-76CH00016.

A survey of the superconducting transition temperature T_c of $YBa_2Cu_3O_{7-\delta}$ (1:2:3) and related superconductors as a function of pressure $p(\leq 17$ kbar) was made. Well-characterized samples, among them fully oxidized and oxygen-reduced 1:2:3 and Cu-substituted $YBa_2(Cu_{1-xM_x})_3O_{7-\delta}$ (*M*=Fe, Co, Al, Cr, Ni, and Zn), were prepared according to published methods. Small pieces (~100 mg) of the samples were measured for superconductivity using an ac mutual inductance method. For $YBa_2Cu_3O_7$ little pressure dependence is observed ($dT_c/dp \approx -0.01 \pm 0.02$ K/kbar), in agreement with most previous work. However, with substitutions

M=Fe, Co, or Al, a significant positive pressure dependence of T_c is observed, increasing with increasing M content. For M=Zn and Ni there is little pressure dependence of T_c. For an oxygen-reduced sample (δ=0.2) T_c increases with pressure.

37265 Numerical investigation of a model for oxygen ordering in $YBa_2Cu_3O_{6+x}$. Aukrust, T. (IBM Bergen Scientific Centre, Thormohlensgate 55, Bergen High Technology Centre, N-5008 Bergen, Norway (NO)); Novotny, M.A. *Physical Review, B: Condensed Matter (USA),* 41(13): 8772-8791 (1 May 1990). DOE Contract FC05-85ER25000.

We report the results of large-scale Monte Carlo and transfer-matrix studies of a model lattice-gas Hamiltonian that has previously been introduced to stidy the oxygen ordering responsible for the orthorhombic-to-tetragonal transition in $YBa_2Cu_3O_{6+x}$. We analyze the data using finite-size scaling to obtain the phase diagram and critical exponents. At high temperatures we find qualitative agreement with the cluster-variation method. However, at low temperatures we find only second-order transitions, in disagreement with the cluster-variation method. The critical exponents found are consistent with the universality classes of the d=2 Ising model and the XY model with cubic anisotropy. Consequently, any experimental evidence of a first-order transition for $YBa_2Cu_3O_{6+x}$ would imply that the model of Wille, Berera, and de Fontaine [Phys. Rev. Lett. 60, 1065 (1988)] needs to be modified to be directly applicable to this material.

37266 Raman-active phonons of a twin-free $YBa_2Cu_3O_7$ crystal: A complete polarization analysis. McCarty, K.F. (Sandia National Laboratories, Livermore, California 94551 (USA)); Liu, J.Z.; Shelton, R.N.; Radousky, H.B. *Physical Review, B: Condensed Matter (USA),* 41(13): 8792-8797 (1 May 1990). DOE Contract AC04-76DP00789.

A complete Raman analysis has been performed on a high-quality $YBa_2Cu_3O_7$ crystal made free of twins by a mechanical detwinning process. Marked a-b anisotropy is observed in the intensity of the A_g phonons at 116, 335, and 495 cm^{-1}. At room temperature, the α_{yy} component of the polarizability tensor of the 116-cm^{-1} phonon is strongly coupled to an electronic continuum, the α_{xx} component is less strongly coupled, and the coupling of the α_{zz} component is not apparent in the Raman line shape. B_{2g} and B_{3g} phonon pairs are reproducibly found at 70 and 83 cm^{-1}, 142 and 140 cm^{-1}, 210 and 303 cm^{-1}, and 579 and 526 cm^{-1}. Comparison of the observed B_{2g}-B_{3g} pairs to literature calculations of frequencies is made.

37267 Effect of microstructural changes on thermally activated flux-creep behavior in the Bi-Sr-Ca-Cu-O system. Shi, D. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439 (USA)); Xu, M.; Fang, M.M.; Chen, J.G.; Cornelius, A.L.; Lanan, S.G. *Physical Review, B: Condensed Matter (USA),* 41(13): 8833-8837 (1 May 1990).

We measured magnetic relaxation for the zero-field-cooled magnetization of liquid-quenched Bi-Sr-Ca-Cu-O samples with various microstructures at an applied field of 1 kOe. We found that a large amount of crystal defects observed in the sample matrix greatly increase the pinning strength and, in turn, enhance the flux-creep behavior. The relaxation rate peaks at 14 K and drops to zero near 60 K. The increased activation energy in our crystallized samples is attributed to strong pinning caused by a high density of precipitates and lattice stacking faults.

37268 Muon-spin-relaxation and neutron-scattering studies of magnetism in single-crystal $La_{1.94}Sr_{0.06}CuO_4$. Sternlieb, B.J. (Physics Department, Columbia University, New York, NY (USA)); Luke, G.M.; Uemura, Y.J.; Riseman, T.M.; Brewer, J.H.; Gehring, P.M.; Yamada, K.; Hidaka, Y.; Murakami, T.; Thurston, T.R. *Physical Review, B: Condensed Matter (USA),* 41(13): 8866-8871 (1 May 1990). DOE Contract AC02-76CH00016.

Combined muon-spin-relaxation (μ^+SR) and elastic magnetic neutron-scattering experiments on a large single crystal of $La_{1.94}Sr_{0.06}CuO_4$ are reported. μ^+SR data taken without an external field indicate that the Cu spins are fluctuating slowly or frozen below $T_f^{\mu} \approx 6.0$ K. At 3.9 K, measurements done with an applied longitudinal field show that the muon depolarization is almost completely due to static moments. Neutron measurements of the magnetic peaks $\mathbf{Q}$=(1,0,0) and (0,1,1) show that no three-dimensional long-range order is present down to 1.8 K. However, the quasielastic scattering intensity from the two-dimensional ridge $\mathbf{Q}$=(1,k,0) at k=−0.12 increases sharply between 40 and 20 K. Below T_f^N=20 K the scattering intensity is roughly constant. The difference between these two freezing temperatures is explained in terms of the different range of fluctuation frequencies to which each of these probes is sensitive. The dependence of the freezing temperature on the frequency windows of different probes is similar to that seen in traditional spin-glass materials like *Cu*Mn.

37269 Filled-band model leading to supercurrents in La-Ba-Cu-O. Nettel, S.J. (Department of Physics, Tensselaer Polytechnic Institute, Troy, NY (USA)); Gravina, S.; MacCrone, R.K. *Physical Review, B: Condensed Matter (USA),* 41(13): 8964-8967 (1 May 1990). DOE Contract FG02-88ER45362.

A mechanism previously suggested as leading to high-T_c superconductivity in CdS is applied to La-Ba-Cu-O. It is based on full electron bands in a Brillouin zone bounded by the soft-tilting-mode wave vectors. The drive here comes from the interaction between the applied magnetic field and the Cu spins that still have antiferromagnetic correlation within the Cu-O planes.

37270 Temperature and frequency dependences of the dielectric properties of $YBa_2Cu_3O_{6+x}$ ($x \approx 0$). Samara, G.A. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, New Mexico 87185 (USA)); Hammetter, W.F.; Venturini, E.L. *Physical Review, B: Condensed Matter (USA),* 41(13): 8974-8980 (1 May 1990). DOE Contract AC04-76DP00789.

The real (ϵ') and imaginary (ϵ'') parts of the dielectric constant of dense tetragonal ceramic (91–93% of theoretical density) $YBa_2Cu_3O_{6+x}$ samples with x=0.04 and 0.06 were investigated as functions of temperature (4–300 K) and frequency (10^2–10^5 Hz). At 4K the dielectric loss is very small (tan δ<0.005) and ϵ'=14.7±0.3, independent of frequency. This value of ϵ' represents the intrinsic value of the static dielectric constant of the material, i.e., the combined electronic and lattice contributions to ϵ'. Both ϵ' and ϵ'' exhibit small increases with increasing temperature at low temperatures—behavior characteristic of normal dielectrics; however, on further heating strong increases and frequency dispersions develop. Above ~160 K, the $\epsilon'(T)$ and $\epsilon''(T)$ responses are nearly exponential. These temperature and frequency effects are interpreted in terms of dipolar polarization associated with the hopping motion of localized charge carriers. Consistent with this view, the observed frequency dependence of the conductivity is found to obey a power law of the form $\sigma(\omega)=A\omega^s$, where s is a temperature-dependent constant (<1) and ω is the angular frequency. The results can be well represented by Pike's classical hopping model which yields explicitly the ω^s behavior, the temperature dependence of s, and the energy barrier to the hopping process.

37271 Density-of-states-driven transition from superconductivity to ferromagnetism in $Ce(Ru_{1-x}Rh_x)_3B_2$: Scenario for an exchange-split Kondo resonance. Allen, J.W. (Department of Physics, University of Michigan, Ann Arbor, Michigan 48109-1120 (USA)); Maple, M.B.; Kang, J.; Yang, K.N.; Torikachvili, M.S.; Lassailly, Y. *Physical Review, B: Condensed Matter (USA),* 41(13): 9013-9023 (1 May 1990).

We have investigated the interesting alloy system $Ce(Ru_{1-x}Rh_x)_3B_2$, where the physical properties change from superconducting to ferromagnetic as x changes from 0 to 1. We report the results of transport, magnetic, crystallographic, and electron-spectroscopy measurements, and a theoretical analysis of the electron-spectroscopy data using the impurity Anderson Hamiltonian applied to the Ce 4f electrons. Superconductivity exists in the range $0<x<0.38$, while ferromagnetism occurs in the range $0.84<x<1$. Our studies of superconductivity and ferromagnetism in $Ce(Ru_{1-x}Rh_x)_3B_2$ show that ferromagnetism is associated with nearly trivalent Ce ions. We find that the alloying mechanism controlling the low-energy properties of this system is the transition-metal 4d density of states at the Fermi level, rather than any parameter directly connected to the 4f states, such as its binding energy, Coulomb interaction, or the average hybridization strength between the localized 4f and conduction electrons. We use this

result to further elucidate our previously proposed exchange split-Kondo resonance model of the ferromagnetism near x=1.

37272 Thermal conductivity of single-crystal Bi-Sr-Ca-Cu-O. Crommie, M.F. (Department of Physics, University of California at Berkeley, Berkeley, California 94720 and Materials and Chemical Sciences (US)— Division of the Lawrence Berkeley Laboratory, Berkeley, California 94720); Zettl, A. *Physical Review, B: Condensed Matter (USA),* 41(16): 10978-10982 (1 Jun 1990). DOE Contract AC03-76SF00098.

The *ab*-plane thermal conductivity κ of single-crystal $Bi_2Sr_2CaCu_2O_{8-x}$ has been measured from 25 to 300 K, for samples of varying oxygen configuration. Complementary electrical-conductivity measurements on the same crystals allow κ to be accurately decomposed into electronic and phonon contributions. For metallic samples the electronic contribution to κ is substantial. Analysis of κ in the normal and superconducting states allows the defect-scattering and electron-scattering contributions to κ_{phonon} to be evaluated near T_c. κ in the superconducting state is consistent with a BCS description.

37273 Monte Carlo study of tracer and chemical diffusion of oxygen in $YBa_2Cu_3O_{6+2c}$. Salomons, E. (Department of Materials Science and Mineral Engineering, University of California, Berkeley, Berkeley, California 94720 (US)— Lawrence Berkeley Laboratory, Berkeley, California 94720); de Fontaine, D. *Physical Review, B: Condensed Matter (USA),* 41(16): 11159-11167 (1 Jun 1990).

Tracer and chemical diffusion of oxygen in $YBa_2Cu_3O_{6+2c}$ has been studied by Monte Carlo simulations of an asymmetric next-nearest-neighbor Ising model. Striking differences between tracer and chemical diffusion are found and explained by the effect of the thermodynamic factor, which is determined also by Monte Carlo simulation. Especially for c≈0.5, the effect of the thermodynamic factor is large. It is also found that tracer diffusion in the ordered orthorhombic phase of $YBa_2Cu_3O_{6+2c}$ is strongly anisotropic, which is explained in terms of different diffusion mechanisms.

37274 Spin and charge excitations in $YBa_2Cu_3O_7$: Constraints from spin-relaxation rates in the normal state. Monien, H. (Department of Physics, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801 (USA)); Pines, D.; Slichter, C.P. *Physical Review, B: Condensed Matter (USA),* 41(16): 11120-11127 (1 Jun 1990). DOE Contract AC02-76ER01198.

We analyze the measured Cu spin-relaxation data for a single crystal of $YBa_2Cu_3O_7$ and deduce, within 30%, the relevant hyperfine couplings, and the associated fluctuation times, for Cu nuclei in the planar and chain sites. We discuss constraints placed thereby on one- and two-component theories. Our deduced values for the hyperfine couplings are in good agreement with the quantum-chemical analysis proposed by Mila and Rice.

37275 Metallization and superconducting properties of $YBa_2Cu_3O_{6.2}Br_y$. Radousky, H.B. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550 (USA)); Glass, R.S.; Hahn, P.A.; Fluss, M.J.; Meisenheimer, R.G.; Bonner, B.P.; Mertzbacher, C.I.; Larson, E.M.; McKeegan, K.D.; O'Brien, J.C. *Physical Review, B: Condensed Matter (USA),* 41(16): 11140-11148 (1 Jun 1990). DOE Contract W-7405-ENG-48.

Low-temperature (260 °C) and short-time (>5-min) treatment of initially insulating $YBa_2Cu_3O_{6.2}$ with Br_2 gas converts the material into a 90-K superconductor. Bromine diffusion is found to be four orders of magnitude greater than oxygen diffusion at the same temperature. The crystal structure, phase purity, microstructure, thermal stability, and oxygen content have been studied using x-ray-diffraction Rietveld analysis, Raman spectroscopy, x-ray-fluorescence microprobe, and thermal gravimetric analysis. Superconducting and normal-state properties of the brominated material have been studied with diffuse infrared reflectivity and magnetization.

37276 Superconductivity and oxygen ordering in $(Ca,Ba,La)Cu_3O_{7-\delta}$. Bjornholm, T. (Department of Physics and Institute for Pure and Applied Physical Sciences, University of California, San Diego, La Jolla, California 92093 (USA)); Schuller, I.K.; Early, E.A.; Maple, M.B.; Wuyts, B.; Vanacken, J.; Bruynseraede, Y. *Physical Review, B: Condensed Matter (USA),* 41(16): 11154-11158 (1 Jun 1990). DOE Contract FG03-86ER45230.

Magnetization measurements on polycrystalline samples with nominal composition $Y_{1-x}Ca_xBa_{2-x}La_xCu_3O_{7-\delta}$ (x=0.0, 0.05, 0.10, 0.50, and 1.0) show that only samples with x=1.0 or 0.0 contain a single *superconducting* phase. Gas evolution experiments on $(Ca,Ba,La)Cu_3O_{7-\delta}$ (x=1.0, δ∼0.07) reveal the presence of an oxygen phase that is indistinguishable from the oxygen chain structure of $YBa_2Cu_3O_{7-\delta}$ (x=0.0, δ∼0.05); however, the total amount of evolved oxygen is very different between the two phases. These studies suggest that two phases coexist in $(Ca,Ba,La)Cu_3O_{7-\delta}$: a *superconducting* phase in which La^{3+} ions occupy the Y^{3+} sites, and a second *nonsuperconducting* phase where Ca^{2+} ions occupy the Y^{3+} sites.

37277 Two- and three-dimensional magnetic order of the rare-earth ions in $RBa_2Cu_4O_8$. Zhang, H. (Center for Superconductivity Research, Department of Physics, University of Maryland, College Park, Maryland 20742 (USA)— National Institute of Standards and Technology, Gaithersburg, Maryland 20899 (USA)); Lynn, J.W.; Li, W.; Clinton, T.W.; Mor *Physical Review, B: Condensed Matter (USA),* 41(16): 11229-11236 (1 Jun 1990).

Neutron scattering has been used to investigate the magnetic ordering of the rare-earth ions in the $ErBa_2Cu_4O_8$ and $DyBa_2Cu_4O_8$ materials. For the Er system a simple three-dimensional (3D) antiferromagnetic structure is observed, in which the magnetic unit cell is twice the chemical unit cell along the *a* axis, with a Neel temperature T_N≈0.49 K. In the vicinity of the Neel temperature, however, scattering characteristic of two-dimensional behavior, indicative of the strong anisotropy of the magnetic interactions, is observed. The magnetic anisotropy arises naturally from the crystal structure, as the *c*-axis spacing of the magnetic ions is ∼3 times the *a*-*b* spacing. 2D behavior is also observed in the Dy material near its Neel temperature of ∼0.9 K. However, the scattering in the Dy system does not cross over to the expected 3D Bragg peaks at low temperatures, but rather the 2D line shape persists to the lowest temperatures measured. We explain this result as originating from a geometric cancellation of interactions between *c*-axis layers for the specific Dy *a*-*b* spin configuration, which together with the weak intrinsic *c*-axis interaction renders the *net* interaction along the *c* axis much smaller than all other known "2D magnets." Hence the 2D and 3D ordering temperatures appear to be quite different for the Dy material. We anticipate that a similar cancellation of interactions is likely to occur in other $RBa_2Cu_4O_8$ (*R* being a rare-earth element) systems.

37278 Anomalous pressure dependence of optical reflectivity in the superconductor $Ba_{0.6}K_{0.4}BiO_3$. Bonner, B.P. (Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550 (USA)); Reichlin, R.; Martin, S.; Radousky, H.B.; Folkerts, T.J.; Shelton, R.N. *Physical Review, B: Condensed Matter (USA),* 41(16): 11576-11578 (1 Jun 1990). DOE Contract W-7405-ENG-48.

The pressure dependence of visible and near-infrared reflectivity of the superconducting compound $Ba_{0.6}K_{0.4}BiO_3$ has been measured to 40 GPa at room temperature. The reflectivity decreases dramatically up to the maximum applied pressure, in marked contrast to copper oxide–based high-T_c superconducting materials.

37279 Lorentz-force independence of resistance tails in magnetic fields near T_c for the low-temperature superconductor granular NbN: A Josephson-junction model. Kim, D.H. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)); Gray, K.E.; Kampwirth, R.T.; Woo, K.C.; McKay, D.M.; Stein, J. *Physical Review, B: Condensed Matter (USA),* 41(16): 11642-11645 (1 Jun 1990). DOE Contract W-31-109-ENG-38.

The broadened resistive transitions in a granular NbN film have been measured for field orientations *both perpendicular and parallel to the current.* These are essentially the same over a span of six orders of magnitude below the normal-state resistance (just above T_c) demonstrating the absence of the macroscopic Lorentz force. We show that a model of Josephson coupling between grains, rather than flux motion, can *quantitatively* explain the results with no adjustable parameters. Broadening of the resistive

transitions of high-temperature superconductors (HTS) has also been shown to be independent of the macroscopic Lorentz force. This research demonstrates unambiguously that resistive losses near T_c and the absence of the macroscopic Lorentz force on them are not restricted to exotic HTS.

3606 Other Materials

Refer also to citation(s) 36779, 36785, 36786, 36841, 37002, 37163, 37168, 37177, 37178, 37189, 37191, 37230, 37241, 37243, 37247, 37332, 37344, 37369, 37399, 37405, 37407, 37410, 37413, 37517, 37959, 37960, 38134

37280 (BNL–42887) **Figure and finish of grazing incidence mirrors.** Takacs, P.Z. (Brookhaven National Lab., Upton, NY (USA)); Church, E.L. Brookhaven National Lab., Upton, NY (USA). Aug 1989. 43p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-890802–31: 1989 synchrotron radiation instrumentation (SRI) national conference, Berkeley, CA (USA), 6-10 Aug 1989). Order Number DE90012872. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Great improvement has been made in the past several years in the quality of optical components used in synchrotron radiation (SR) beamlines. Most of this progress has been the result of vastly improved metrology techniques and instrumentation permitting rapid and accurate measurement of the surface finish and figure on grazing incidence optics. A significant theoretical effort has linked the actual performance of components used as x-ray wavelengths to their topological properties as measured by surface profiling instruments. Next-generation advanced light sources will require optical components and systems to have sub-arc second surface figure tolerances. This paper will explore the consequences of these requirements in terms of manufacturing tolerances to see if the present manufacturing state-of-the-art is capable of producing the required surfaces. 15 refs., 14 figs., 2 tabs.

37281 (CONF-900466–63) **Incoherent imaging of materials structure and composition by Z-contrast stem.** Pennycook, S.J.; Jesson, D.E.; Chisholm, M.F. Oak Ridge National Lab., TN (USA). May 1990. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Spring meeting of the Materials Research Society; San Francisco, CA (USA); 16-21 Apr 1990. Order Number DE90012789. Available from NTIS, PC A03/MF A01 - OSTI.

It is shown how the use of a high angle annular detector in a STEM provides images which show strong compositional sensitivity and almost perfect incoherent characteristics. No contrast reversals occur with defocus or sample thickness and the contribution of an atomic string is insensitive to the distribution and strength of neighboring strings. The image is best described in real space as a simple convolution of the incident probe intensity profile with an object function sharply peaked at the atomic strings having a strength dependent on composition. How the incoherent characteristics arise is described using a Bloch wave approach and examples are shown on interfaces in semiconductor and superconductor materials. 34 refs., 13 figs.

37282 (DOE/ER/13648–7) **Theoretical studies of multicomponent mixtures: Phase equilibrium and transport: Progress report, September 1, 1988–May 15, 1990.** Kincaid, J.M. State Univ. of New York, Stony Brook, NY (USA). Dept. of Mechanical Engineering. 15 May 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER13648. Order Number DE90012530. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We report here on research projects supported by the Office of Energy Research during the period 1 September 1988 through 15 May 1990. In Section 1 we describe a new series-expansion method for solving the equilibrium conditions and representing thermophysical properties: in Section 2 we report on the continued development of the xMET. (Extended Modified Enskog Theory). A list of our publications and preprints is given in Section 3.

37283 (EGG-M–90228) **Chlorinated hydrocarbon substitution program.** Harris, T.L.; Tsang, M.N. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC07-76ID01570. (CONF-9005226–1: 5. annual aerospace hazardous waste management, Costa Mesa, CA (USA), 22-24 May 1990). Order Number DE90012705. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

At Air Force Logistic Command Centers located worldwide, toxic wastes that are generated by aircraft refurbishing and refinishing processes are a problem of major concern. Helping to solve this waste problem are EG&G scientists who have identified a number of biodegradable solvents that can replace chlorinated hydrocarbon solvents. The objective of Phase i was to gather baseline information, to conduct screening test of possible commercially available, alternative paint stripping formulations, and to select the most promising for further testing. In addition, this phase identified mechanical methods of paint stripping and addressed specific problems associated with each. The Phase 2 objective will consist of pilot-scale verification studies of the solvents selected from Phase 1. Concurrently, methods will be studied to solve waste problems resulting from mechanical stripping. The objective for Phase 3 is to implement the alternative paint strippers at Tinker Air Logistic Center and to pursue new technologies in mechanical stripping methods.

37284 (EGG-MS–8933) **Vitreous joining of SiC fiber reinforced SiC composites.** Coon, D.N. (Wyoming Univ., Laramie, WY (USA). Dept. of Mechanical Engineering). EG and G Idaho, Inc., Idaho Falls, ID (USA). Dec 1989. 69p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE90012951. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Glass in the $MgO–Li_2O–Al_2O_3–SiO_2$ system were developed to as brazing materials to join SiC fiber reinforced SiC composites. These glass materials will melt and flow at temperatures ranging from 1000°C to 1200°C, and are chemically compatible with SiC. The glass transition temperature and melting temperature can be altered by adjusting the $MgO:Li_2O$ ratio. The glasses exhibited viscous deformation at their glass transition temperatures, 490°C to 725°C. The glasses were devitrified to develop crystalline phases based on β'-spodumene, β'-eucryptite, or a β'-spodumene-β'-eucryptite solid solution. Glass-ceramics, prepared by thermal treatment, exhibited no viscous deformation to temperature as high as 785°C, and exhibited improved strength as the test temperature was increased. Joints were prepared by painting the composite surface with a slurry of the glass powder suspended in water. Joining temperature, joining time, glass composition, amount of joining glass, and post-joining heat treatments were the variables examined. Larger quantities of joining glass and shorter joining times were observed to improve joint strength. The addition of niobium oxide to the glass also improved joint strength. The niobium oxide also stabilizes the glass/composite interface at temperatures less than 1200°C.

37285 (EP-PICM-RA–1988) **Interfaces and thin films physics.** Equer, B. (Centre National de la Recherche Scientifique (CNRS), 75 - Paris (FR)). Ecole Polytechnique, 91 - Palaiseau (France). 1988. 18p. (In French). Order Number DE90500831. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the interfaces and Thin Film Physics laboratory (Polytechnic School France) is presented. The research program is focused on the thin films and on the interfaces of the amorphous semiconductor materials: silicon and silicon germanium, silicon-carbon and silicon-nitrogen alloys. In particular, the following topics are discussed: the basic processes and the kinetics of the reactive gas deposition, the amorphous materials manufacturing, the physico-chemical characterization of thin films and interfaces and the electron transport in amorphous semiconductors. The construction and optimization of experimental devices, as well as the activities concerning instrumentation, are also described.

37286 (K/ETO–29) **Selected properties of c-perfluorobutane.** Harkins, D.A. Oak Ridge Gaseous Diffusion Plant, TN (USA). Jun 1990. 16p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OT21400. Order Number DE90012869. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

There is currently an effort under way to select a suitable substitute for the coolant in use at DOE gaseous diffusion plants. The evaluation of c-perfluorobutane (C_4F_8) as a possible alternative refrigerant includes computer modeling of its performance in existing systems. Certain properties of the material are required as input for this modeling. These properties must be approximated when actual measurements have not been performed. This report provides C_4F_8 data from experiments published in the open literature and applies published approximation methods to these data where necessary to extend them to the expected conditions of C_4F_8 use. The specific properties reported herein are the saturation pressure, density, heat of vaporization, heat capacity, thermal conductivity, surface tension, and viscosity of C_4F_8 under saturation conditions. Work done on the evaluation of some other properties (e.g., the enthalpy and entropy of C_4C_8) is also briefly discussed. The values reported herein represent the best information currently available and should be used in the computer modeling of c-perfluorobutane performance. 25 refs., 10 tabs.

37287 (LA-UR–90-1348) **Nonlinear elastic wave interactions in rock.** Johnson, P.A.; Shankland, T.J. Los Alamos National Lab., NM (USA). [1990]. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-900893–1: 12. international symposium on nonlinear acoustics, Austin, TX (USA), 26-31 Aug 1990). Order Number DE90010601. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We are exploiting the nonlinear elastic properties of rocks to generate low-frequency, long-wavelength elastic wave beams. The appeal of rocks for nonlinear studies arises from their numerous microcracks that compress readily under applied stress. The result is large changes of elastic moduli and wave velocities with pressure in comparison with crystals, glasses, or liquids. In laboratory studies, we established that nonlinear elastic wave interactions take place in rock by verifying selection rules derived from the nonlinear elastic wave equation. The definitive work came from continuous-wave (CW) mode observations of the general case where two driving signals, intersecting at a prescribed angle, produced a difference frequency (Δf) beam at a different angle. Further, with pulsed drivers we measured Δf beam travel times that agreed with predicted times. Most recently, we obtained propagation path lengths using a CW-mode interference method. 7 refs., 4 figs.

37288 (LBL–28747) **Magnetic field dependence of the specific heat of heavy-fermion $YbCu_{4.5}$.** Amato, A. (Lawrence Berkeley Lab., CA (USA)); Fisher, R.A.; Phillips, N.E.; Jaccard, D.; Walker, E. Lawrence Berkeley Lab., CA (USA). Mar 1990. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-900806–9: 19. international conference on low temperature physics, Brighton (UK), 16-22 Aug 1990). Order Number DE90011602. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The specific heat of a polycrystalline sample of $YbCu_{4.5}$ has been measured between 0.3 and 20K in magnetic fields to 7T. At zero field a minimum in C/T is observed near 11K. Below that temperature C/T increases and below 0.5K exhibits an upturn ascribed to a hyperfine contribution. The increase in C/T below 11K is reduced by a factor 1.5 for H = 7T, whereas the hyperfine term is enhanced due to the contribution of the ^{63}Cu and ^{65}Cu and nuclei. 5 refs., 3 figs.

37289 (ORNL/FTR–3008) **[Theoretical techniques for dynamics studies of polymers]: Foreign trip report, July 30–August 22, 1988.** Noid, D.W. Oak Ridge National Lab., TN (USA). 28 Aug 1988. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012358. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended a Workshop on new computer methods to implement various theoretical techniques to study the dynamics of polymers and their conformations. Most of the discussion of most interest to ORNL concerned the use of transputers to perform the large number of calculations needed to generate classical trajectories of polymers and to compute structure of polymers using molecular mechanics. Much of the development work on transputers was carried out at Oxford, and during the Workshop various projects were developed on the 40-node transputer at Oxford.

37290 (ORNL/FTR–3643) **[Radiation materials science in the Soviet Union]: Foreign trip report, May 19–31, 1990.** Mansur, L.K. Oak Ridge National Lab., TN (USA). 15 Jun 1990. 34p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012804. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The conference reflected the high level of effort on radiation effects in materials in the Soviet Union. About 400 reports were covered, distributed over four days in plenary sessions, two-track parallel sessions and poster presentations. There were approximately 300 attendees, with about 30 from outside the USSR. The point was made that a number of Soviet reports had to be turned away in order to keep the conference at reasonable size. Fifteen countries were represented. The conference scope ranged from overviews of nuclear power and policy in the USSR to details of point defect behavior. Both applied and basic materials work here were covered extensively. The number of researchers in this field appears to be several times, perhaps a factor of ten, higher than in the United States.

37291 (PB–90-193095/XAB) **Vectorial electron transfer on designed surfaces. Final report, February 1984-December 1989.** Bard, A.J.; Campion, A.; Fox, M.A.; Mallouk, T.E.; Webber, S.E. Texas Univ., Austin, TX (USA). Dept. of Chemistry. 1989. 97p. Available from NTIS, PC A05/MF A01.

See also PB–84-198530.

The transition of semiconductor chalcogenides from molecular MX to bulk material has been observed in a Nafion cation-exchange membrane. Ultrasmall particles of MX had been formed using a technique analogous to an inverted micelle microemulsion method, wherein the M ion/cluster ratio is controlled by dilution with an inert ion. Photoreactivity of such quantum-sized particles is size-dependent, with enhanced reducibility attainable on small particles. The effects of moisture in forming larger aggregates, including time dependence, and the introduction of layered structure have been evaluated by spectroscopic methods. Photosensitization by adsorbed dye molecules on titanium dioxide electrodes prepared from a titanium-aluminum alloy on a titanium sheet has been evaluated by monitoring photosensitized current production and photoanodic decomposition of water. The titanium dioxide electrodes were characterized by a scanning electron microscopy, x-ray photoelectron spectroscopy, energy dispersive x-ray analysis, and x-ray diffraction.

37292 (SAND–89-2787C) **Short-range structure of fluorine-modified phosphate glass.** Osborne, Z.A.; Brow, R.K.; Tallant, D.R. Sandia National Labs., Albuquerque, NM (USA). [1990]. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900756–9: SPIE's international symposium on optical and optoelectronic applied science and engineering and exhibit, San Diego, CA (USA), 8-13 Jul 1990). Order Number DE90013494. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Raman and x-ray photoelectron spectroscopy are used to characterize the effects of fluorine incorporation on the short range structures of several simple phosphate glasses. Fluorine depolymerizes the chain structure of $NaPO_3$ by replacing bridging POP bonds with terminal PF species. In aluminophosphate glasses with small fluorine contents, fluorine is primarily associated with aluminum. When the fluorine to aluminum ratio exceeds three, the number of Al-F bonds are maximized and significant numbers of P-F bonds form. 21 refs., 6 figs.

37293 (SAND–89-7139) **Research on design and fabrication of high-efficiency solar cells.** Rohatgi, A. (Georgia Inst. of Tech., Atlanta, GA (USA). School of Electrical Engineering); Ringel, S.R.; Smith, A.W. Sandia National Labs., Albuquerque, NM (USA). Jun 1990. 120p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. Order Number DE90012010. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The overall objective of this program was to investigate the loss mechanisms in Si and GaAs solar cells and to provide guidelines for improving the performance. Major emphasis was placed in the following two areas: (1) modeling and quantifying the effect of trap location and light trapping on cell performance, and (2) determining

the loss mechanisms in experimental cells through a combination of device and materials characterization and detailed modelling of device characteristics (illuminated and dark current-voltage characteristics and spectral response). Optimal design of solar cells was found to be very sensitive to the deep level. A program for analysis of various light-trapping geometries by means of ray-tracing calculations was begun. Finally, a novel "thin base" design is proposed for GaAs solar cells that can be more efficient and more tolerant of poor-quality material than present designs. 65 refs., 45 figs., 7 tabs.

37294 (SAND–90-0217) **Evolution of structure and viscoelasticity in diethanolamine-cured epoxy.** Adolf, D.; Martin, J.E. Sandia National Labs., Albuquerque, NM (USA). Jun 1990. 30p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. Order Number DE90011256. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

As a crosslinking polymer cures, dramatic changes in molecular architecture occur. These structural changes in turn affect the viscoelastic behavior of the material. At a critical extent of reaction (the gel point), the polymer undergoes a transition from a viscous liquid to an elastic solid. We have monitored the evolution of structure and viscoelasticity in the most common epoxy encapsulant used at Sandia, diethanolamine-cured Epon 828. The structure evolves according to percolation theory, and the viscoelasticity evolves according to our dynamic scaling theory for branched polymers. 9 refs., 12 figs.

37295 (SAND–90-0638C) **Thermal expansion of beta-eucryptite filled bismaleimide and glass/bismaleimide composites.** Allred, R.E. (PDA Engineering, Albuquerque, NM (USA)); Drotning, W.D.; Warren, W.E. Sandia National Labs., Albuquerque, NM (USA). [1990]. 15p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9006121–6: 4. international SAMPE electronic materials and processes conference, Albuquerque, NM (USA), 12-14 Jun 1990). Order Number DE90013072. Available from NTIS, PC A03/MF A01 - OSTI.

The use of a negative coefficient of thermal expansion (CTE) mineral filler (β-eucryptite) is examined as a means of reducing CTE of a bismaleimide polymer (Kerimid 601). Results show that β-eucryptite is effective in lowering CTE of the polymer and of glass fabric composites with a filled matrix phase. A theoretical model is presented that effectively predicts CTE of the filled BMI but underestimates the observed results by approximately 15%. The lower predicted CTE is believed to be due to poor interfacial adhesion at the β-eucryptite/bismaleimide interface. Poor interfacial adhesion is supported by ultimate tensile strength results. 27 refs., 7 figs., 3 tabs.

37296 (SAND–90-1560C) **Application of InAlAs/GaAs superlattice alloys to GaAs solar cells.** Drummond, T.J. (Sandia National Labs., Albuquerque, NM (USA)); Gee, J.; Terry, F.L.; Weng, R. Sandia National Labs., Albuquerque, NM (USA). [1990]. 6p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-900542–13: 21. Institute for Electrical and Electronics Engineers photovoltaic specialists conference, Kissimmee, FL (USA), 21-25 May 1990). Order Number DE90013070. Available from NTIS, PC A02/MF A01 - OSTI.

AlGaAs/GaAs solar cells are typically characterized as having relatively high interface recombination velocities at the heteroface. This work examines some of the factors influencing the design of solar cell window layers and considers the effect of substituting InAlAs/GaAs superlattice alloys and InAlAs bulk alloys in place of AlGaAs. Potential advantages are reduced surface recombination at the heterojunction, reduced thermionic emission into the window layer, thinner window layers and reduced absorption in the window layer. 9 refs., 5 figs.

37297 (UCID–21513) **Species-diffusion phenomena in glass: A one-dimensional, transient model.** Kang, Sang-Wook. Lawrence Livermore National Lab., CA (USA). 28 Sep 1988. 15p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90010373. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The diffusion characteristics of a liquid in a solid have been theoretically analyzed by formulating a time-dependent, one- dimensional model. This work is a part of an Engineering Research programmatic effort to delineate the dominant factors involved in polishing, especially the role of chemistry and its associated diffusion inside a glass material. The model includes the effects of various physical factors such as temperature, local water concentration, tensile or compressive stress, and chemical reactions with other species in glass. The formulated model equations have been solved on a CRAY computer by utilizing the PDEPAC numerical method. Sample calculation results suggest that the above-mentioned physical factors all play a role in water diffusion in glass. The local temperature effect, however, and that of stresses, seem to be especially dominant over the other factors. Work is continuing on these effects as well as on characterizing the material removal process to ascertain whether chemistry is indeed important in glass-polishing processes. 23 refs., 6 figs.

37298 (UCRL–102447) **Development of a drug assay using surface-enhanced Raman spectroscopy.** Angel, S.M.; Roe, J.N.; Andresen, B.D.; Myrick, M.L.; Milanovich, F.P. Lawrence Livermore National Lab., CA (USA). May 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. Contract RPIS 003906. (CONF-900140–29: SPIE optics, electro-optics and laser applications in science and engineering conference and exhibition, Los Angeles, CA (USA), 15-19 Jan 1990). Order Number DE90012992. Available from NTIS, PC A02/MF A01 - OSTI.

Surface-enhanced Raman spectroscopy has been used to detect low levels of several chemical compounds, including the drugs of abuse – cocaine hydrochloride and methamphetamine hydrochloride. Raman spectra of these substances have also been taken over optical fibers using red-wavelength excitation. These measurements demonstrate the feasibility of the remote red-wavelength excitation. These measurements demonstrate the feasibility of the remote determination of various target chemicals using diode excitation and diode array detection. 5 refs., 5 figs.

37299 Polymeric electrolytes and polyelectrolytes: Salt concentration and domain. Ratner, M.A. (Dept. of Chemistry and Materials Research Center, Northwestern Univ., Evanston, IL (US)); Druger, S.D.; Nitzan, A. pp. 13-25 of Solid state ionics. Nazri, G.; Huggins, R.A.; Shriver, D.F. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-8811221–: Solid state ionics, Boston, MA (USA), 28 Nov - 2 dec 1988).

Solvent-free polymer electrolytes and polyelectrolytes are usually studied at quite high ionic concentrations (into the range above 1 M). Under these conditions, correlation effects arising from ion-polymer and ion-ion interactions are expected to be important in the mechanism of conductivity. The authors sketch some specific ionic effects, separating those acting on the mobility from those effecting carrier concentration.

37300 Molecular dynamics simulation of mass and charge transport in superionic conductors, and structural correlations in chalcogenide glasses. Vashishta, P. (Material Science Div., Argonne National Lab., Argonnne, IL (US)); Kalia, R.K.; Rino, J.P. pp. 27-41 of Solid state ionics. Nazri, G.; Huggins, R.A.; Shriver, D.F. Materials Research Society, Pittsburgh, PA (USA) (1989). DOE Contract W-31-109-ENG-38. (CONF-8811221–: Solid state ionics, Boston, MA (USA), 28 Nov - 2 dec 1988).

Structural properties, single-particle dynamics, and the charge transport are studied in superionic conductor Ag_2Se using the molecular dynamics (MD) technique. The calculations are based on a model of interionic potentials in which ions interact through Coulomb interaction, steric repulsion and charge-dipole interaction due to the large electronic polarizability of the selenium ions. Structural and dynamics correlations are studied at five temperatures in the superionic phase. Among the structural correlations the results are presented for partial pair correlation function, coordination numbers, bond angle distributions and wave-vector dependence of the Bragg intensities. Detailed comparison with neutron and x-ray single crystal diffraction experiments. The calculated temperature dependence of the self-diffusion constant of silver is in good agreement with the tracer diffusion measurements. The spectra of velocity autocorrelation functions and the frequency dependent

ionic conductivity are calculated. The Haven's ratio is also in good agreement with experiments.

37301 Non-random mixing and fast ion decoupling in lithium chloroborate superionic glasses: An ion dynamics computer simulation study. Syed, R. (Dept. of Chemistry, Purdue Univ., West Lafayette, IN (US)); Kieffer, J.; Angell, C.A. pp. 63-72 of Solid state ionics. Nazri, G.; Huggins, R.A.; Shriver, D.F. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-8811221–: Solid state ionics, Boston, MA (USA), 28 Nov - 2 dec 1988).

Li^+ ions are highly mobile in $LiCl\text{-}Li_2O \cdot 2B_2O_3$ glasses to the extent that the decoupling of conductive modes of motion from the viscous modes, assessed at the glass transition temperature T_g by a relaxation time ratio, is one of the greatest known. The interpretation of the structure of this glass system and its relation to conductivity decoupling is not very advanced at this time but there seems to be a distinction drawn between the chloroborate structure and the structure of the corresponding AgCl-Ag borate and AgI-borate glasses. The latter have frequently been discussed in terms of α-AgI percolating clusters although the available thermodynamic evidence indicates chemical ordering (negative deviations from ideal mixing) as opposed to any sort of clustering (positive deviations from ideal mixing). The $LiCl\text{-}Li_2O\text{-}B_2O_3$ system is interesting to us because simple transferable effective pair potentials are available for all species in the system and ion dynamics computer simulations should be capable of giving useful insights into the structure, energetics, and dynamics of the system. The authors present diffusivity data as a function of temperature for several compositions in the $LiCl\text{-}Li_2O \cdot 2B_2O_3$ system and observe that the Li^+ mobility remains high below the simulated glass transition.

37302 Hopping model for the non-debye dielectric response in ionic crystals. Wang, J.C. (Solid State Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp. 57-62 of Solid state ionics. Nazri, G.; Huggins, R.A.; Shriver, D.F. Materials Research Society, Pittsburgh, PA (USA) (1989). DOE Contract AC05-84OR21400. (CONF-8811221–: Solid state ionics, Boston, MA (USA), 28 Nov - 2 dec 1988).

A model based on ion hopping in potential double-wells is proposed to explain the non-Debye dielectric response in solids. Relying on some assumptions, an attempt is made to remove the average nature of previous diffusion theories. This results in a distribution of activation energies, G(E), which decays exponentially on both sides of some given value E_o. It is shown that the existence of a dielectric loss peak is a result of the decay of G(E) for $E > E_o$, the constant-phase-angle behavior above the loss peak is associated with the decay of G(E) for $E < E_o$, and G(E) can produce all the main features of the empirical Havriliak-Negami function. An interesting property of this G(E) is that it broadens with increasing temperature, consistent with many experimental observations.

37303 Structural changes in fast ion conducting chloride Doped potassium borate glasses. Fusco, F.A. (Massachusetts Inst. of Technology, Crystal Physics and Optical Electronics Lab., Dept. of Materials Science and Engineering, Cambridge, MA (US)); Tuller, H.L.; Massot, M.; Oueslati, M.; Harro, E.; Balkanski, M. pp. 189-197 of Solid state ionics. Nazri, G.; Huggins, R.A.; Shriver, D.F. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-8811221–: Solid state ionics, Boston, MA (USA), 28 Nov - 2 dec 1988).

The effects of halide substitution on ionic conductivity in potassium borate glasses are different from those observed in their Li and Na analogs. Physical property and Raman spectroscopy results suggest that this behavior is associated with differences in the glass network structure induced by the presence of different interstitial alkali cations.

37304 Optical damage in epoxy polymers by millisecond light pulses. Wolfe, C.R. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA (US)); Campbell, J.H.; Lyon, R.E.; Pitts, J.H.; Powell, H.T. pp. 194-205 of Laser induced damage in optical materials 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). (CONF-861124–: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

The authors have studied optical damage in epoxy based polymers used to attach cladding onto the edge of laser disks of the Nova laser. Damage was produced by exposing the polymers to a 20-40 J/cm^2 fluence of broad band Xe-flashlamp light having a pulselength of approximately 0.5 ms. This stimulates the pump environment of Nd:glass laser amplifiers. The predominant damage mechanisms appear to be pyrolysis, associated with absorbing inclusions and photolysis, associated with intrinsic absorption of the polymer. The amount of damage can be minimized by: careful filtering of the polymer to reduce the presence of foreign material, minimizing the near UV absorption of the polymer and reducing the UV emission of the flashlamps.

37305 Defect relaxation in disordered materials: Stretched exponentials, Meyer-Neldel rule, and Staebler-Wronski effect. Crandell, R.S. (SERI, Golden, CO (US)). pp. 589-594 of Amorphous silicon technology-1989. Madan, A.; Thompson, M.J.; Taylor, P.C.; Hamakawa, Y.; LeComber, P.G. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-890426–: Spring meeting of the Materials Research Society, San Diego, CA (USA), 24-28 Apr 1989).

Using an exponential distribution of activation barriers, annealing data for metastable effects in hydrogenated amorphous silicon, a-Si:H, are quantitatively explained. This includes the stretched exponential time dependence of annealing and a Meyer-Neldel rule for the annealing time constant. An exponential distribution of annealing energies arises because defects are frozen in during growth at high temperature. Mechanisms that lead to an exponential distribution of annealing energies are weak bond-breaking and charge trapping.

37306 Microvoids and photoconductivities in a-SiC:H and a-Si:H. Mahan, A.H. (Solar Energy Research Institute, Golden, CO (US)); Williamson, D.L.; Nelson, B.P. pp. 539-544 of Amorphous silicon technology-1989. Madan, A.; Thompson, M.J.; Taylor, P.C.; Hamakawa, Y.; LeComber, P.G. Materials Research Society, Pittsburgh, PA (USA) (1989). (CONF-890426–: Spring meeting of the Materials Research Society, San Diego, CA (USA), 24-28 Apr 1989).

Small microvoids having a radius of gyration between 3.3Å-4.6Å are found by the small angle x-ray scattering (SAXS) technique to exist in both glow discharge $a\text{-}Si_{1-x}C_x\text{:}H$ ($0< x <0.3$) and a-Si:H ($40°C<T_s<250°C$) films. Included in these results are the first observation of microvoids, as detected by SAXS, in device quality a-Si:H. The volume fraction of microvoids (v_f) is found to increase from 0.01 in device quality a-Si:H to greater than 0.20 for both the a-SiC:H(x =.30) and a-Si:H(T_s = 40°C) films. Tilting experiments indicate that the microvoids are non-oriented (spherical) in a-SiC:H and are oriented (columnar) in non-device quality a-Si:H. The normalized coplanar photoconductivities of all samples decrease with increasing v_f, but for a given v_f the photoconductivity is larger in a-SiC:H than in a-Si:H. The authors discuss reasons for this behavior.

37307 Enhanced ionic conductivity in composite electrolytes. Dudney, N.J. (Solid State Div., Oak Ridge National Lab., Oak Ridge, TN (US)). pp. 611 of Solid state ionics. Nazri, G.; Huggins, R.A.; Shriver, D.F. Materials Research Society, Pittsburgh, PA (USA) (1989). DOE Contract AC05-84OR21400. (CONF-8811221–: Solid state ionics, Boston, MA (USA), 28 Nov - 2 dec 1988).

The ionic conductivity of a large number of electrolyte materials, such as LiI, AgCl, AgI and CuCl, is known to be enhanced by the addition of inert submicron particles, most often alumina. Typically the conductivity is enhanced by 1 to 3 orders of magnitude for composites containing 10 to 40 volume % particles. Several other researchers have attributed this effect to an enhanced carrier concentration in a space charge polarization layer surrounding the alumina particles. Estimates of the magnitude of such a space charge layer indicate that this mechanism alone can not account for the large enhanced conductivities reported for several of the composites.

37308 Absolute x-ray power measurements with subnanosecond time resolution using type IIa diamond photoconductors. Kania, D.R. (Lawrence Livermore National Laboratory, Livermore, California 94550 (US)); Pan, L.S.; Bell, P.;

Landen, O.L.; Kornblum, H.; Pianetta, P.; Perry, M.D. *Journal of Applied Physics (USA)*, 68(1): 124-130 (1 Jul 1990).

Photoconductive devices have been fabricated from type IIa diamonds. The sensitivity of these devices is independent of photon energy from 200 to 2200 eV. The dynamic range is 10^5. The large band gap of the diamond greatly reduces the sensitivity to photons with an energy less than 5.5 eV which is an attractive feature for many applications. The carrier lifetime in the material is 90 ps and the mobility is 1650 $cm^2/V/s$ at 10^6 V/m.

37309 Electron paramagnetic resonance and capacitance-voltage studies of ultraviolet irradiated Si-SiO_2 interfaces. Brower, K.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800 (US)); Schubert, W.K.; Seager, C.H. *Journal of Applied Physics (USA)*, 68(1): 366-368 (1 Jul 1990). DOE Contract AC04-76DP00789.

Electron paramagnetic resonance and capacitance-voltage studies of hydrogen passivated Si-SiO_2 interfaces indicate that UV irradiation of the interface does not result in the creation of new P_b centers or interface states providing no photocurrent is allowed to pass through the oxide. This is in contrast to the generally known fact that UV irradiation with photoinjection does form interface states.

37310 Formation of $In_xGa_{1-x}As/GaAs$ heteroepitaxial layers using a pulsed laser driven rapid melt-solidification process. Chang, Y. (Solid State Laboratory, Stanford University, Stanford, CA (USA)); Chou, S.Y.; Sigmon, T.W.; Marshall, A.F.; Weiner, K.H. *Applied Physics Letters (USA)*, 56(19): 1844-1846 (7 May 1990).

Heteroepitaxial $In_xGa_{1-x}As/GaAs$ structures have been formed for the first time by pulsed laser induced mixing of molecular beam epitaxy deposited In films (~200 A) on GaAs (100) substrates. The process occurs by a melt-induced, rapid-mixing and solidification process driven by a XeCl pulsed excimer laser. The laser has a 27 ns full width at half maximum pulse width at 308 nm with its energy density of 0.28–0.61 J cm^{-2} homogenized into a 4×4 mm square area which is stepped across the wafer. $In_xGa_{1-x}As$ layers with x values, as determined by both x-ray diffraction and Rutherford backscattering spectrometry simulation ranging from x=0.21–0.26 and thicknesses of 77–94 nm, have been formed. The formation of single-crystal layers has been verified by ^4He ion channeling and cross-section transmission electron microscopy.

37311 Growth studies of pseudomorphic GaAs/InGaAs/AlGaAs modulation-doped field-effect transistor structures. Chan, K.T. (Microwave Technology Division, Hewlett-Packard Co., 1412 Fountaingrove Parkway, California 95403 (USA)); Lightner, M.J.; Patterson, G.A.; Yu, K.M. *Applied Physics Letters (USA)*, 56(20): 2022-2024 (14 May 1990). DOE Contract AC03-76SF00098.

Strained GaAs/InGaAs/AlGaAs quantum well structures have been grown by molecular beam epitaxy at substrate temperatures from 375 to 510 °C. The well layer thickness and In composition are analyzed by ion channeling and particle-induced x-ray emission as a function of growth temperature. Test structures for modulation-doped field-effect transistors grown at 375 and 510 °C under two different As_4 overpressures were also characterized by Van der Pauw measurements and low-temperature photoluminescence. The observed differences in film quality can be explained by the influence of substrate temperature and As_4 flux on the cation surface mobility during growth of the InGaAs layer.

37312 Diffraction broadening and suppression of the inelastic channel in resonant neutron scattering. Hastings, J.B. (Brookhaven National Laboratory, Upton, New York 11973 (USA)); Siddons, D.P.; Lehmann, M. *Physical Review Letters (USA)*, 64(17): 2030-2033 (23 Apr 1990). DOE Contract AC02-76CH00016.

The direct consequences of the phased excitation (Bragg scattering) by neutrons of an ordered array of resonant nuclei are observed experimentally for ^{115}In in a nearly perfect single crystal of InSb. The energy width of the peak in the integrated intensity of the (640) Bragg reflection at the 1.457-eV resonance is more than 3 times greater than that for an isolated nucleus. Anomalous transmission of neutrons at the (642) Bragg reflection is observed for a crystal with μt=44, consistent with the predicted suppression of the inelastic (n,γ) decay channel.

37313 Biexcitonic autoionization in naphthalene trimer clusters. Wessel, J. (Chemistry and Physics Laboratory, The Aerospace Corporation, Los Angeles, California 90009 (USA)). *Physical Review Letters (USA)*, 64(17): 2046-2049 (23 Apr 1990). DOE Contract FG03-86ER60391.

Exciton annihilation processes involving biexcitonic interactions are known to efficiently ionize molecular and semiconductor crystals and large molecular clusters. We present the first spectroscopic evidence for biexcitonic two-photon ionization of small molecular clusters. In this case the process resembles resonant multiphoton autoionization of two-electron atoms.

37314 Smectic-layer growth at solid interfaces. Ocko, B.M. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973 (USA)). *Physical Review Letters (USA)*, 64(18): 2160-2163 (30 Apr 1990). DOE Contract AC02-76CH00016.

X-ray reflectivity is used to study the temperature-dependent smectic layering of the cyanobiphenyl compounds (*n*CB) in the isotropic phase at alkylsilane-coated silicon surfaces. Layer-by-layer growth is observed for 11CB and 12CB. Comparison of the layering transition temperatures with measurements at the vapor interface is used to determine the relative anchoring strengths at the two interfaces.

37315 Total dose radiation hardness of diamond-based silicon-on-insulator structures. Landstrass, M.I. (Crystallume, 125 Constitution Drive, Menlo Park, California 94025 (US)); Fleetwood, D.M. *Applied Physics Letters (USA)*, 56(23): 2316-2318 (4 Jun 1990). DOE Contract AC04-76DP00789.

Total dose radiation hardness measurements were performed on silicon-on-insulator (SOI) test structures where the insulator is chemical vapor deposited (CVD) diamond. These measurements represent a first look at the fundamental radiation response of low-pressure CVD synthetic diamond materials for SOI applications. Silicon/diamond metal-insulator-semiconductor (MIS) capacitors were subjected to both cobalt-60 and 10 keV x-ray irradiation up to doses of 1×10^7 rad (SiO_2) while under positive, negative, and zero bias conditions. The diamond insulators used in these devices were found to be free from extensive hole or electron trapping. This behavior is consistent with the high electron and hole mobility of the polycrystalline diamond insulator.

37316 Probing the Coulomb gap in insulating *n*-type CdSe. Zhang, Y. (City College of the City University of New York, New York, New York 10031 (US)); Dai, P.; Levy, M.; Sarachik, M.P. *Physical Review Letters (USA)*, 64(22): 2687-2690 (28 May 1990). DOE Contract FG02-84ER45153.

We report the first observation of a crossover with decreasing temperature of the resistivity of a doped semiconductor from the $\exp(T_0/T)^{1/4}$ behavior characteristic of Mott variable-range hopping to the $\exp(T_0'/T)^{1/2}$ form expected in the presence of a Coulomb gap. Simultaneous determination of T_0 and T_0' for several dopant concentrations yields the empirical relation $T_0' \propto T_0^p$, with $p\approx2/3$. If current theory is valid and applicable, this has unexpected implications regarding the critical behavior of the localization length and the dielectric constant at the metal-insulator transition.

37317 Observation of ballistic phonons in silicon crystals induced by α particles. Young, B.A. (Physics Department, Stanford University, Stanford, California 94305 (US)); Cabrera, B.; Lee, A.T. *Physical Review Letters (USA)*, 64(23): 2795-2798 (4 Jun 1990). DOE Contract AM03-76SF00326.

We have observed the ballistic-phonon-focusing pattern along the [100] axis of a 1-mm-thick silicon crystal using α-particle bombardment as the phonon source. These experiments on phonon-mediated particle detection are performed in vacuum at about 400 mK and use titanium-superconducting-transition-edge phonon sensors on the crystal surfaces. The ballistic time of flight is confirmed in one experiment and the focusing patterns are spatially resolved in another. These data indicate that about 1/3 of the phonon energy striking the back face during the first μsec is ballistic.

37318 Fast aggregation of colloidal silica. Martin, J.E. (Sandia National Laboratories, Albuquerque, New Mexico 87185 (USA)); Wilcoxon, J.P.; Schaefer, D.; Odinek, J. *Physical Review, A (General Physics) (USA),* 41(8): 4379-4391 (15 Apr 1990). DOE Contract AC04-76DP00789.

The aggregation kinetics of colloidal silica is highly dependent on conditions such as the *p*H and salt concentration. In this paper we investigate the aggregation of colloidal silica under conditions that promote rapid growth, contrasting our findings with earlier investigations of the slow growth of silica. A number of interesting effects are observed, including power-law growth of the mean aggregate radius, dependence of the aggregation rate on concentration and the chemical nature of the salt used, a reduced aggregate fractal dimension, fragmentation of the fast aggregates under changing solution conditions, and shear-induced restructuring of aggregates. Finally, we present evidence that the fractal dimension of aggregates is not strongly universal, but depends weakly on such factors as the solution concentration. We conclude that although the diffusion-limited cluster-cluster aggregation model gives a good first-order description of rapid aggregation, real systems exhibit richer behavior that is not given to such a facile interpretation.

37319 dc electrical conductivity of D-T gas. Wolfer, W.G. (Sandia National Laboratories, Livermore, California 94550 (USA)); Bisson, C.L.; Souers, P.C.; Tsugawa, R.T. *Physical Review, A (General Physics) (USA),* 41(8): 4470-4477 (15 Apr 1990). DOE Contract W-7405-ENG-48 ;AC04-76DP00789.

The space charge and the electrical current in a weakly ionized radioactive gas is theoretically evaluated. The results are compared with experimental data for a deuterium gas at room temperature containing 0.1 mol % of tritium. The dc electrical conductivity has been measured for gas densities from 0.1 to 10 mol/l and applied voltages over the range 0.1 to 400 V. The resulting current density increases with increasing gas density and the decreases at higher densities. The theoretical results show that the charge-density profiles in the gas as well as the space-charge potential change dramatically with the applied voltage. Varying the electronic recombination coefficients until theoretical predictions agree with the measured results provides a means to determine them. From this comparison it is found that the three-body recombination coefficients is 6.2×10^{-26} cm^6 s^{-1}, whereas the two-body recombination coefficient is indeterminate and of little influence on the quality of the fit as long as its value is below 10^{-5} cm^3 s^{-1}.

37320 A lattice model describing hydrogen bonding in polymer mixtures. Painter, P.C. (Department of Materials Science and Engineering, The Pennsylvania State University, University Park, Pennsylvania 16802 (USA)); Graf, J.; Coleman, M.M. *Journal of Chemical Physics (USA),* 92(10): 6166-6174 (15 May 1990).

A Flory lattice model is used to obtain an expression for the free energy of mixing polymers that hydrogen bond. The derivation is based on the determination of the probability that a mixture of the nonhydrogen bonded chains would spontaneously occur in a configuration equivalent to the hydrogen bonded system. Our result has three parts. The usual contribution to the free energy from mixing covalent chains, a contribution from the hydrogen bonds that is equal to the result that would be obtained if the segments were not covalently linked, and a "correction" term that accounts for the excess entropy of mixing introduced by the second term. A consequence of this model is that there should be no dependence of the equilibrium constants describing hydrogen bonding upon covalent chain length.

37321 Anomalous elastic behavior in superlattices of twist grain boundaries in silicon. Phillpot, S.R. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439 (USA)); Wolf, D.; Lutsko, J.F. *Journal of Applied Physics (USA),* 67(11): 6747-6759 (1 Jun 1990). DOE Contract W-31109-ENG-38.

The elastic constants and moduli of superlattices of high-angle twist grain boundaries on the two densest crystallographic planes of silicon are calculated using Stillinger and Weber's three-body potential. While in both cases the Young's and shear moduli are found to be softened, the Poisson ratios and some elastic constants, in particular C_{33} (in the direction of the interface-plane normal), are found to be hardened. It is shown that the elastic behavior is determined by the structural disorder at the interfaces, and that it cannot be understood in terms of the dimensional changes of the system alone. A comparison with similar calculations for metallic superlattices elucidates the role of the covalent nature of bonding of silicon on its elastic behavior.

37322 Growth of Al oxide layers on GaAs (100) by reaction with condensed molecular oxygen. Gao, Y. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627-0011 (USA)); Lusignan, C.P.; Ruckman, M.W.; Strongin, M. *Journal of Applied Physics (USA),* 67(11): 7148-7151 (1 Jun 1990). DOE Contract AC02-76CH00016.

An Al oxide-GaAs (100) interface fabricated by the reactive deposition of Al into a molecular oxygen overlayer on a gallium terminated GaAs (100) surface at T=49 K is studied by synchrotron radiation photoemission. Al forms a stable oxide layer by reaction with O_2 until all the oxygen is consumed. Limited oxidation of surface As atoms (≈20%) is observed during the initial deposition of Al, but further Al deposition reduces the AsO bond. The well-known exchange reaction between Al and Ga when Al is directly deposited on GaAs (100) is not observed.

37323 Production and depletion of long-lived charged nonbond-alternating defects in polyacetylene with mid-band-gap photolysis. Hoener, C.F. (Laboratory of Chemical Biodynamics, Lawrence Berkeley Laboratory, Berkeley, California 94720 (US)). *Journal of Chemical Physics (USA),* 92(12): 7643-7652 (15 Jun 1990). DOE Contract AC03-76SF00098.

Photoinduced IR absorptions at 1368, 1289, and 640 cm^{-1} with much longer lifetimes and lower excitation energies than those previously reported have been observed in polyacetylene. These "persistent" photoinduced IR absorptions were observed after the photolysis of polyacetylene at temperatures below 125 K with ν>5500 cm^{-1}. The IR absorption frequencies are similar to the previously reported transient (τ≈1 ms) photoinduced IR absorptions which are attributed to charged solitons. The persistent photoinduced IR absorptions reported here decay slowly in the dark over the course of several hours. The disappearance of these absorptions can be accelerated by photoexcitation of an electronic transition with an onset near 2800 cm^{-1} and an absorption maximum near 4000 cm^{-1}. Two mechanisms are proposed to explain the production of IR-active defects at such low photolysis frequencies.

37324 Four-wave mixing of Nd^{3+}-doped crystals and glasses. Powell, R.C. (University of California, Lawrence Livermore National Laboratory, P.O. Box 5508, Livermore, California 94550 (USA)); Payne, S.A.; Chase, L.L.; Wilke, G.D. *Physical Review, B: Condensed Matter (USA),* 41(13): 8593-8602 (1 May 1990).

Degenerate four-wave-mixing measurements have been performed on a wide variety of Nd^{3+}-doped oxide and fluoride glasses and crystals. Crossed beams from a cw argon-ion laser were used to excite the Nd^{3+} ions directly and establish population gratings. Absolute measurements of the signal strengths were made, and their magnitudes were found to be sensitively influenced by the composition of the host. A theoretical model was developed to interpret the results, and it was found that the dominant contribution to the signal is associated with the difference in polarizability of the Nd^{3+} ions in the metastable state versus the ground state. The magnitude of the observed change in the polarizability indicates that the $4f\rightarrow5d$ transitions are responsible for this effect, and as a result, the value of the $\langle 4f|r|5d\rangle$ radial integral sensitively affects the calculated polarizability change.

37325 Magnetic susceptibility of californium fluorides. Chang, C.P. (Department of Physics, University of Tennessee, Knoxville, Tennessee 37996-1200 (USA)); Haire, R.G.; Nave, S.E. *Physical Review, B: Condensed Matter (USA),* 41(13): 9045-9048 (1 May 1990).

Results of magnetic measurements are presented for polycrystalline samples of CfF_3 (both the hexagonal-LaF_3-type and orthorhombic-YF_3-type crystal structures) and CfF_4 (monoclinic-UF_4-type). Measurements were performed at temperatures between 4.2 and 340 K and in magnetic fields of up to 50 kG. The effective paramagnetic moments, μ_{eff}, and the Weiss constants, $FTHETA_P$, have been determined in the Curie-Weiss temperature region (150–340 K). In the trifluorides no significant differences in

μ_{eff} and *FTHETA*$_P$ were observed as a function of crystal structure or sample age (radiation damage). For the tetrafluoride, two distinct sets of values for μ_{eff} and *FTHETA*$_P$ were obtained depending on the sample age. Antiferromagnetic ordering was observed in both Cf compounds at temperatures below 12 K. Crystal-field effects were evident in the temperature range between about 12 and 150 K. The calculated susceptibilities for these compounds are presented and discussed.

37326 Magic-angle spinning ^{29}Si NMR study of short-range order in a-Si. Shao, W. (Ames Laboratory, U.S. Department of Energy, Iowa State University, Ames, Iowa 50011-3020 (USA)); Shinar, J.; Gerstein, B.C.; Li, F.; Lannin, J.S. *Physical Review, B: Condensed Matter (USA)*, 41(13): 9491-9494 (1 May 1990). DOE Contract W-7405-ENG-82.

The magic-angle spinning ^{29}Si NMR of annealed rf-sputter-deposited amorphous silicon was measured as a function of annealing temperature up to crystallization. The NMR peak width is observed to narrow significantly with little change in peak position. A comparison with Raman-scattering and neutron-diffraction results indicates that the distribution of NMR chemical shifts is modified by variations of the electronic density of states with bond-angle distribution.

40 CHEMISTRY

Refer also to citation(s) 37176, 37204, 37539

37327 (ORNL–6596) **Chemical Technology Division progress report for the period July 1, 1988 to September 30, 1989.** Oak Ridge National Lab., TN (USA). Mar 1990. 240p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012002. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

This progress report summarizes the research and development efforts conducted in the Chemical Technology Division (Chem Tech) during the period July 1, 1988, through September 30, 1989. The following major areas are covered: waste management and environmental programs, the Waste Management Technology Center, radiochemical and isotope programs, basic science and technology, Nuclear Regulatory Commission and Electric Power Research Institute severe accident research programs, the Office of Safety and Operational Readiness, and administrative resources and facilities.

37328 Gas-phase photoinduced reactivity of $RhC_5H_6^+$ with cyclopentane. Gord, J.R. (Purdue Univ., West Lafayette, IN (USA)); Buckner, S.W.; Freiser, B.S. *Journal of the American Chemical Society (USA)*, 111(10): 3753-3754 (10 May 1989). DOE Contract FG02-87ER13776.

In the mature area of solution-phase photochemistry, a limitless number of examples exist in which a species, activated by the absorption of a photon, undergoes a reaction not observed in its ground state. In contrast, under the conditions used to study gas-phase ion-molecule chemistry at low pressures (10^{-5}-10^{-9} Torr), examples of photoinduced or photoenhanced reactions have been surprisingly sparse. In this environment, the time between reactive collisions is sufficiently long that internal conversion, photodissociation, or radiative and collisional relaxation of photoexcited ions significantly reduce the possibility of photoinduced reactivity. In this communication, $(CH_3OH)H^+(OH_2) + CH_3OH \rightleftharpoons^{k_f}_{k_r} (CH_3OH)_2H^+ + H_2O$, the authors report an example of photoinduced reactivity in the ICR pressure regime and the first such example involving an organometallic ion.

37329 Gas-phase photoinduced reactivity of Co_2NO^+ with O_2 via a photoisomerization mechanism. Gord, J.R. (Purdue Univ., West Lafayette, IN (USA)); Freiser, B.S. *Journal of the American Chemical Society (USA)*, 111(10): 3754-3755 (10 May 1989). DOE Contract FG02-87ER13776.

Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR-MS) has emerged as an ideal technique for the study of gas-phase ion-molecular chemistry. FT-ICR-MS methodology has recently been applied to investigate the fundamental properties of bare and ligated metal ions as well as metal cluster ions. These studies further their understanding of catalytic processes in the gas phase as well as in condensed phases. The authors demonstrate that the nonreactive isomer can be photoinduced to react with O_2. This experiment constitutes the third example of photoinduced reactivity observed in the low-pressure regime characteristic of an FT-ICR-MS. In addition, this is the first example of such a reaction proceeding by a photoisomerization mechanism, as recently proposed in ref 5.

4001 Analytical and Separations Chemistry

Refer also to citation(s) 36721, 36737, 37144, 37177, 37306, 37327, 37345, 37389, 37616, 37653, 37960, 38347

37330 (DOE/ER/13859–6) **Effects of extracolumn convolution on preparative chromatographic peak shapes.** Dose, E.V. (Tennessee Univ., Knoxville, TN (USA). Dept. of Chemistry); Guiochon, G. Tennessee Univ., Knoxville, TN (USA). Dept. of Chemistry. [1990]. 39p. Sponsored by U.S. DOE Energy Research; National Science Foundation. DOE Contract FG05-88ER13859. Grant CHE-8901382. Order Number DE90012441. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The effect of extracolumn components on preparative (nonlinear) chromatographic peak shapes are investigated by convoluting column inlet and outlet profiles of chromatographic simulations with Gaussian and exponential spreading functions. Broadening of the inlet profile serves mainly to retard elution of the peaks. The chromatogram base line width is very sensitive to small amounts of broadening at the outlet (detector). While linear chromatography is modelled by simple shift-invariant convolution, nonlinear chromatography requires the more complex shift-invariant convolution model. This removes the property of variance additivity familiar in linear chromatography. The relative utilities of three measures of preparative chromatographic peak width are tested using the convoluted peak shapes obtained. 50 refs., 11 figs.

37331 (DOE/ER/75151–T1) **DOE/University instrumentation program grant for funding of the high field, high mass, double focusing, high resolution mass spectrometer: Final report.** Michigan State Univ., East Lansing, MI (USA). Jun 1987. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-84ER75151. Order Number DE90012443. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This document discusses the research efforts accomplished using the double focusing, high field, high resolution mass spectrometer, Model JMS HX-100HF (JEOL). Installation of this instrument was accomplished during March of 1986 and operation of the instrument for purposes of application to biological and biochemical problems started during the month of April 1986. areas of research include post-translational modifications of rubisco, biosynthesis of abscisic acid, environmental control of plant development, plant cell wall protein, structural studies of thioltransferase and hexokinase and analogs of peptide harmones and neurotransmitters. 1 fig.

37332 (EGG-M–90237) **Phenomenology, diagnostics, and non-LTE effects in plasma-particle interactions.** Shaw, C.B. Jr.; Snyder, S.C.; Eddy, T.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC07-76ID01570. (CONF-9005183–3: 8. symposium on energy engineering sciences, Argonne, IL (USA), 9-11 May 1990). Order Number DE90013088. Available from NTIS, PC A02/MF A01 - OSTI.

Two phenomena of plasma-particle interactions are reported: creation of comet-like plasma plumes downstream from each particle after initial heating, and failure of the particles (but not the "comets") to follow fluctuations in the visible plasma. A diagnostic method to measure true gas temperature and flow fields in thermal plasmas by Doppler-shifted Rayleigh scattering is reported in detail. Evidence for departure of plasmas from local thermal equilibrium (LTE) is presented, and its significance briefly discussed. 9 refs., 7 figs.

37333 (LUTFD2-TFKF–1013-1-112-1989) **Development of a scanning proton microprobe - computer-control, elemental mapping and applications.** Loevestam, Goeran. Lund Univ. (Sweden). Dept. of Nuclear Physics. Aug 1989. 97p. Order Number

DE90631037. Available from NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

The thesis includes 6 papers.

A scanning proton microprobe set-up has been developed at the Pelletron accelerator in Lund. A magnetic beam scanning system and a computer-control system for beam scanning and data aquisition is described. The computer system consists of a VMEbus front-end computer and a μVax-II host-computer, interfaced by means of a high-speed data link. The VMEbus computer controls data acquisition, beam charge monitoring and beam scanning while the more sophisticated work of elemental mapping and spectrum evaluations is left to the μVax-II. The calibration of the set-up is described as well as several applications. Elemental micro patterns in tree rings and bark has been investigated by means of elemental mapping and quantitative analysis. Large variations of elemental concentrations have been found for several elements within a single tree ring. An external beam set-up has been developed in addition to the proton microprobe set-up. The external beam has been used for the analysis of antique papyrus documents. Using a scanning sample procedure and particle induced X-ray emission (PIXE) analysis, damaged and missing characters of the text could be made visible by means of multivariate statistical data evaluation and elemental mapping. Also aspects of elemental mapping by means of scanning μPIXE analysis are discussed. Spectrum background, target thickness variations and pile-up are shown to influence the structure of elemental maps considerably. In addition, a semi-quantification procedure has been developed. (author).

37334 (ORNL–6606) **Analytical Chemistry Division annual progress report for period ending December 31, 1989.** Oak Ridge National Lab., TN (USA). Apr 1990. 156p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012024. Available from NTIS, PC A07/MF A01; OSTI; INIS; GPO Dep.

The Analytical Chemistry Division of Oak Ridge National Laboratory (ORNL) is a large and diversified organization. As such, it serves a multitude of functions for a clientele that exists both in and outside of ORNL. These functions fall into the following general categories: Analytical Research, Development and Implementation; Programmatic Research, Development, and Utilization; and Technical Support. The Analytical Chemistry Division is organized into four major sections, each which may carry out any of the three types of work mentioned above. Chapters 1 through 4 of this report highlight progress within the four sections during the period January 1 to December 31, 1989. A brief discussion of the division's role in an especially important environmental program is given in Chapter 5. Information about quality assurance, safety, and training programs is presented in Chapter 6, along with a tabulation of analyses rendered. Publications, oral presentations, professional activities, educational programs, and seminars are cited in Chapters 7 and 8. Approximately 69 articles, 41 proceedings, and 31 reports were published, and 151 oral presentations were given during this reporting period. Some 308,981 determinations were performed.

37335 (ORNL/TM–11540) **Program for preparing output data from a flow injection spectrometer for entry into AnaLis data base of the Analytical Chemistry Division, Oak Ridge National Laboratory.** Mueller, T.R. Oak Ridge National Lab., TN (USA). May 1990. 99p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90011282. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The Analytical Chemistry Division (ACD) is attempting to improve the quality of data taken from instruments, recorded, and stored in its data base. One avenue for realizing this goal is to reduce the manipulation of data by hand operations. This report describes the design and implementation of a program, FIS-PARSE, that processes output from Lachat, Inc., flow injection optical spectrometer(FIS) and prepares it for storage in the Analytical Chemistry Division's data base, AnaLis; therefore, provision is made for transmittal of both raw data and selected results to archives. It is necessary to review the data before transmitting them to the data base; therefore, direct transfer of results from the computer used to operate the spectrometer was not selected as the method of choice.

37336 Quasielastic γ-ray scattering from pentadecane. Schupp, G. (Department of Physics and Research Reactor, University of Missouri-Columbia, Columbia, Missouri 65211 (USA)); Hammouda, B.; Hsueh, C.M. *Physical Review, A (General Physics) (USA)*, 41(10): 5610-5615 (15 May 1990). DOE Contract FG02-85ER45200.

A recently developed Moessbauer instrument has been used to study the liquid dynamics of pentadecane at various temperatures and scattering angles. Widths of the quasielastic signal extracted from the data ranged between 16 GHz (at 12 °C) and 48 GHz (at 74 °C) at a scattering vector of 1.15 A^{-1}. Similar measurements at five different scattering angles (at 12 °C) were also taken to investigate the Q dependence between 0.82 and 1.56 A^{-1}. The results obtained are in good agreement with classical theory for coherent scattering from liquids.

37337 Ion dip spectroscopy of van der Waals clusters. Stanley, R.J. (Department of Chemistry, Pennsylvania State University, University Park, Pennsylvania 16802 (USA)); Castleman, A.W. Jr. *Journal of Chemical Physics (USA)*, 92(10): 5770-5775 (15 May 1990). DOE Contract FG02-88ER60648.

We report the implementation of ion dip spectroscopy in a supersonic molecular beam time-of-flight mass spectrometer as a powerful mass-selective method for observing ground-state vibrational levels in van der Waals clusters. Ion dip spectra of phenylacetylene and phenylacetylene-NH_3 are demonstrated in the range of 900–1100 cm^{-1}, showing prominent dips at 978.0, 1002.8, and 1028.0 cm^{-1}. These dips have been tentatively assigned as 13^0_1 35^1_1, 11^0_1 35^1_0, and 35^1_2, respectively, in phenylacetylene. Shifts in the 35^1_2 and $11^0_1 35^1_0$ vibrational bands of the complex are observed while the $13^0_1 35^1_1$ band of the complex is either shifted or attenuated.

37338 Infrared diode laser spectroscopy of the ν_3 fundamental of the CD_3 radical. Fawzy, W.M. (Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973 (USA)); Sears, T.J.; Davies, P.B. *Journal of Chemical Physics (USA)*, 92(12): 7021-7026 (15 Jun 1990). DOE Contract AC02-76CH00016.

The infrared absorption spectrum of the ν_3 fundamental band of the CD_3 radical has been detected by diode laser absorption spectroscopy. The CD_3 radical was produced by excimer laser photolysis of CD_3I at 248 nm or $(CD_3)_2CO$ at 193 nm. Molecular parameters of the v_3=1 vibrational state were determined from a least-squares fit to 62 rotation–vibration transitions. In this fit, molecular parameters describing the ground state were constrained to those obtained from previous spectroscopic studies of the ν_2 parallel IR band [J. M. Frye, T. J. Sears, and D. Leitner, J. Chem. Phys. **88**, 5300 (1988)]. The molecular parameters determined in the present work are the band origin ν_0=2381.088 60(84), B'=4.758 737(40), C'=2.373 297(34), $(\zeta C)_3$=0.476 278(72), q_3=0.003 76(59), D'_N =0.000 187 9(5), D_{NK} =−0.000 341 0(12), D'_K =0.000 143 7(8), η_N =−0.000 005 5(36), η'_K =0.000 060(35), and q_N =0.000 063(17), all in cm^{-1} with one standard deviation in parentheses. The derived molecular parameters were compared with those for the CH_3 radical v_3=1 level determined previously [T. Amano, P. Bernath, C. Yamada, Y. Endo, and E. Hirota, J. Chem. Phys. **77**, 5284 (1982)]. The molecular parameters of the v_3=1 state of the CD_3 and CH_3 radicals follow the expected isotopic relationships. We have also found that the determined molecular parameters reasonably satisfy the approximate planarity relationships [J. K. G. Watson, J. Mol. Spectrsoc. **65**, 123 (1977)] and the sign of the l-type doubling constant is consistent with a planar equilibrium structure.

37339 Structure-energy correlation of the intramolecular charge-transfer state in a series of (N,N-diethylanilino) arenes. Tseng, J.C.C. (Univ. of Southern California, Los Angeles (USA)); Singer, L.A. *Journal of Physical Chemistry (USA)*, 93(20): 7092-7095 (5 Oct 1989).

The energies of the charge-transfer state for a series of (N,N-diethylanilino)arenes (1-naphthyl, 1-pyrenyl, 9-anthryl, and 3-fluoranthyl) in acetonitrile correlate well with the one-electron redox potentials of the structural moieties, in accord with a radical cation/radical anion description for this state. Solvent-dependent shifts of

the fluorescences for these compounds indicate highly polar excited states with dipole moments (μ_e) ranging from 13.4 to 20.9 D.

4002 Inorganic, Organic, and Physical Chemistry

Refer also to citation(s) 36699, 36707, 36823, 36900, 37181, 37214, 37217, 37235, 37285, 37328, 37329, 37334, 37339, 37738

37340 (DOE/ER/13295–4) **Transition metal mediated transformations of small molecules: Annual progress report, December 1, 1989–November 30, 1990.** Sen, A. Pennsylvania State Univ., University Park, PA (USA). Dept. of Chemistry. May 1990. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-84ER13295. Order Number DE90012887. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The progress report summarizes the work done in the first 6 months of the current period. During this time we have worked on three different facets of organotransition metal chemistry and homogeneous catalysis and our results to data are briefly summarized. In a series of experiments, we have observed and studied the insertion of a number of olefins into the Pd(II)-COR bonds of the cationic and neutral compounds, trans-$Pd(PPh_3)_2(MeCN)(COR)^+BF_4^-$ and trans-$Pd(PPh_3)_2(Cl)(COR)$, respectively.

37341 (DOE/ER/13580–3) **Mechanisms and controlling characteristics of the catalytic oxidation of methane: Final technical report, June 15, 1986–June 14, 1990.** Klier, K.; Simmons, G.W.; Herman, R.G.; Wang, Yarw-Nan; Marcos, J. Lehigh Univ., Bethlehem, PA (USA). [1990]. 106p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER13580. Order Number DE90012901. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The interaction of oxygen with Pd(100) single crystal surfaces was studied with the objective of determining the mechanisms, the most suitable metallic catalyst, and the most favorable conditions for the oxidation and partial oxidation of methane. The various adsorbed oxygen phases p(2 x 2), 0.25ML; c(2 x 2), 0.50 ML; p(5 x 5), 0.68 ML; and ($\sqrt{5}$x$\sqrt{5}$)R27°, 0.80 ML were produced under conditions of oxygen pressure and surface temperatures that has led to the refinement of the phase diagram for this system. In addition, novel interpretations of the surface structures, surface vibrational spectra, and thermal desorption spectra are offered.

37342 (EP-DCCS-RA–1988) **Quantum chemistry and scientific calculus.** Gervais, H.P. Ecole Polytechnique, 91 - Palaiseau (France). 1988. 17p. (In French). Order Number DE90500858. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the Polytechnic School research team, concerning the quantum chemistry and the scientific calculus. The research program involves the following topics: the transition metals - carbon monoxide systems, which are a suitable model for the chemisorption phenomena; the introduction of the vibronic perturbations in the magnetic screen constants; the gauge invariance method (used in the calculation of the magnetic perturbations), extended to the case of the static or dynamic electrical polarizabilities. The published papers, the congress communications and the thesis are listed.

37343 (EP-DCFI-RA–1988) **Fine chemistry.** Laszlo, P. Ecole Polytechnique, 91 - Palaiseau (France). 1988. 13p. (In French). Order Number DE90500854. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the Fine Chemistry laboratory (Polytechnic School, France) is presented. The research programs are centered on the renewal of the organic chemistry most important reactions and on the invention of new, highly efficient and highly selective reactions, by applying low cost reagents and solvents. An important research domain concerns the study and fabrication of new catalysts. They are obtained by means of the reactive sputtering of the metals and metal oxydes thin films. The Monte Carlo simulations of the long-range electrostatic interaction in a clay and the obtention of acrylamides from anhydrous or acrylic ester are summarized. Moreover, the results obtained in the field of catalysis are also given. The published papers and the congress communications are included.

37344 (EP-DCMR-RA–1988) **Reaction mechanisms.** Nguyen Trong Anh (Centre National de la Recherche Scientifique (CNRS), 75 - Paris (FR)). Ecole Polytechnique, 91 - Palaiseau (France). 1988. 16p. (In French). Order Number DE90500862. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the Reaction Mechanisms laboratory (Polytechnic School, France), is presented. The research topics are: the valence bond methods, the radical chemistry, the modelling of the transition states by applying geometric constraints, the long range interactions (ion - molecule) in gaseous phase, the reaction sites in gaseous phase and the mass spectroscopy applications. The points of convergence between the investigations of the mass spectroscopy and the theoretical chemistry teams, as well as the purposes guiding the research programs, are discussed. The published papers, the conferences, the congress communications and the thesis, are also reported.

37345 (EP-DCPH-RA–1988) **The phosphorus and the transition metals chemistry.** Mathey, F. Ecole Polytechnique, 91 - Palaiseau (France). 1988. 21p. (In French). Order Number DE90500856. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report, concerning the Polytechnic School unit (France), which studies the phosphorus and the transition metals chemistry, is presented. The laboratory activities are related to the following topics: the phosporus heterocyclic chemistry, the phosphorus-carbon double bonds chemistry, the new transition metals phosphorus compounds, the phosphonates and their uses. Some practical applications of homogeneous catalysis and new materials synthesis are investigated. The main results obtained are: the discovery of the tetra-phosphafulvalenes, the utilization of a new synthesis method of the phosphorus-carbon double bonds and the stabilization of the α-phosphonyled carbanions by the lithium diisopropylamidourea. The papers, the congress communications and the thesis are also shown.

37346 (EP-DCSO-RA–1988) **Organic synthesis.** Lallemand, J.Y.; Fetizon, M. Ecole Polytechnique, 91 - Palaiseau (France). 1988. 19p. (In French). Order Number DE90500860. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the Organic Synthesis Chemistry laboratory (Polytechnic School, France), is presented. The laboratory activities are centered on the chemistry of natural products, which have a biological activity and on the development of new reactions, useful in the organic synthesis. The research works involve the following domains: the natural products chemistry which are applied in pharmacology, the plants and insects chemistry, the organic synthesis, the radical chemistry new reactions and the bioorganic physicochemistry. The published papers, the congress communications and the thesis are listed.

37347 (FRCEA-TH–250) **Synthesis and characterization of ruthenium fluorides and oxide fluorides with high oxidation states.** Meublat, L. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie; Paris-11 Univ., 91 - Orsay (France). 1989. 133p. (In French). (CEA-DLPC–89-47). Order Number DE90500634. Available from NTIS (US Sales Only), PC A07/MF A01.

The synthesis of ruthenium fluorides and oxide fluorides with high oxidation states was attempted from dioxide RuO_2 and tetroxide RuO_4. Three fluorinating agents were used: fluorine, chlorine trifluoride and krypton difluoride. The reactions were achieved in anhydrous hydrogen fluoride at room temperature. Thus, the reaction of RuO_4 with ClF_3 enabled us to prepare chloryl hexafluororuthenate (V), $ClO_2^+ RuF_6^-$, a new compound well idendified by vibrational spectroscopy (infra-red and Raman), the structure of which was determined. The reaction of KrF_2 with RuO_4 gave the oxide tetrafluoride $RuOF_4$, the previously published syntheses and properties of which were not in agreement with each other. This compound was definitely characterized here by chemical analysis, infra-red spectroscopy and X-ray powder diffraction. The product of thermal decomposition (70°C) of $RuOF_4$ is presumably RuF_4 since only oxygen is liberated during this decomposition. At last, the reaction of KrF_2 with RuO_2 probably leads to the formation of the new oxide fluoride RuO_2F_4. Indeed, no oxygen is given off during this reaction, the chemical analysis of the red-orange coloured

solid residue is almost in agreement with the one proposed and its infra-red absorption spectrum indicates the presence of ruthenium-oxygen and ruthenium-terminal and bridging fluorine bonds.

37348 (IFP–36-859) **Synthesis of organolanthanides by metal addition on insaturated substrates in ether and reactivity.** Olivier, H. Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France); Paris-6 Univ., 75 (France). 1988. 177p. (In French). Order Number DE90500633. Available from NTIS (US Sales Only), PC A09/MF A01.

The aim of the study is the extension to rare earths of the synthesis, well known for alkaline or alkaline earth metals, by direct metal addition to insaturated substrates in ether and where the metal is directly bound to carbon. A definition of formation conditions and affinity rules is attempled, both with substrates (essentially aromatic hydrocarbons and ketones) and with metals: Yb, Sm, Ce, Nd and others. The nature of obtained products by reaction of electrophiles on synthetised organometallics, allows investigations specific reactivity and structure. Potential catalytic transformation of olefins is precised.

37349 (IS-T–1347) **Kinetics of oxidation of cobalt(II) macrocyclic complexes by tris(bipyridyl)ruthenium(3+) ion.** Lee, Shaoyung. Ames Lab., IA (USA). Feb 1990. 67p. 60. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90011803. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The kinetics of the electron transfer reactions between $Ru(bpy)_3^{3+}$ and selected Co(II) complexes were evaluated by laser flash photolytic methods. The cobalt(II) complexes investigated were $(H_2O)_2Co(N_4mac)^{2+}$, with N_4mac = [14]$aneN_4$, meso-Me_6[14]$aneN_4$, tim or [14]$tetraneN_4$, [15]$aneN_4$ and tmc (tetramethylcyclam). The respective second-order rate constants at 25°C, μ = 0.10M are 2.7×10^7, 4.6×10^6, 2.1×10^7, 1.7×10^7, and 6×10^5 $M^{-1}s^{-1}$. The results have been evaluated for their agreement with Marcus theory. The complex $Co(tmc)^{2+}$ also reacts with $Ru(phen)_3^{3+}$ ($k = 1.0 \times 10^6$ $M^{-1}s^{-1}$) and with Ru(4,7-Me_2phen)$_3^{3+}$ ($k = 3.2 \times 10^4$ $M^{-1}s^{-1}$). 46 refs., 13 figs.

37350 (IS-T–1428) **The oxidative coupling of methane by lanthanum oxide catalysts: The influence of phase morphology on catalytic properties.** Taylor, R.P. Ames Lab., IA (USA). Feb 1990. 148p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90011732. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

The major goal of this research is to make progress towards isolating and identifying the most active and selective phase(s) in the catalytic oxidative coupling of methane to C_2 hydrocarbons by one of the most active and selective "REO" catalysts, "La_2O_3." As discussed in the foregoing literature review, the catalyst preparation methods and the reaction conditions employed can result in the catalyst consisting of several coexisting rare earth compounds. Furthermore, it is conceivable, if not likely, that either the pure REO phase or one of these coexisting compounds is much more catalytically active towards the desired reaction than all others. It is therefore proposed that by employing strict catalyst preparation methods and multi-technique characterization, pure oxide, hydroxide, carbonate, hydroxycarbonate and oxycarbonate phases of lanthanum may be prepared and subsequently tested for catalytic performance such that the extent to which each of these phases are involved in the catalytic oxidative coupling of methane may be determined. 157 refs., 60 figs., 6 tabs.

37351 (IS-T–1470) **The reactivity of the thioalkyne, MeSC≡CSMe, with ruthenium and tungsten complexes.** Miller, D.C. Ames Lab., IA (USA). 13 Jun 1990. 230p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90012445. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

This dissertation describes the synthesis and reactions of ruthenium- and tungsten-thioalkyne complexes. The alkyne, MeSC=CSMe, initially reacts with $Cp(PMe_3)_2RuCl$ to form the sulfur-bound alkyne complex $\{Cp(PMe_3)_2Ru[S(Me)C{=}CSMe]\}^+$, which readily rearranges to the vinylidene $[Cp(PMe_3)_2Ru{=}C{=}C(SMe)_2]^+$. This vinylidene complex is either readily reduced with a variety of charged nucleophiles to give the thioacetylide Cp $(PMe_3)_2$ Ru-C=CSMe and MeSSMe; or reacts with electrophiles H^+ and MeS^+ (E) to give three-member metallacyclic complexes $\{Cp(PMe_3)_2Ru[S(Me)C{=}C{=}(E)SMe]\}^{+2}$.

37352 **Vibrational relaxation of highly excited SiF_4 and C_6F_5H by Ar.** Beck, K.M. (Department of Chemistry, University of Illinois at Chicago, Chicago, Illinois 60680 (USA)); Gordon, R.J. *Journal of Chemical Physics (USA)*, 92(10): 6011-6016 (15 May 1990). DOE Contract FG02-88ER13827.

The vibrational relaxation of SiF_4 and C_6F_5H in an Ar bath was measured as a function of initial energy using the method of time-resolved optoacoustics. SiF_4 was found to relax nonexponentially, with a rate constant which varied approximately as the vibrational energy raised to the 3/2 power. This behavior is similar to that observed earlier for SF_6+Ar below the bottleneck. In contrast, C_6F_5H was observed to decay exponentially, as expected for a large molecule in the quasicontinuum. These two types of behavior are discussed in the context of previously proposed propensity rules for the vibrational relaxation of highly excited molecules.

37353 **High-temperature equilibrium studies of the gaseous thorium chlorides.** Lau, K.H. (SRI International, Menlo Park, California 94025 (USA)); Hildenbrand, D.L. *Journal of Chemical Physics (USA)*, 92(10): 6124-6130 (15 May 1990).

High-temperature gaseous equilibria among the species Th, ThCl, $ThCl_2$, and $ThCl_3$ were studied by mass spectrometry over broad temperature ranges; both enthalpy and entropy data were derived by the second law procedure. In addition, the sublimation of $ThCl_4$ was studied by the torsion-effusion method and the thermodynamics of the gaseous tetrachloride were evaluated. Individual bond dissociation energies in $ThCl_4$ fall within the range 489–545 kJ mol^{-1}, and vary with ligand number in a way similar to ThF_4. Only ThCl appears to have a significant electronic entropy in the experimental temperature range. For $ThCl_4$ the experimental entropy indicates the likelihood of a regular tetrahedral structure as with ThF_4, but unlike the uranium tetrahalides which appear to be distorted tetrahedra. In the mass spectrum of $ThCl_4$, the fragment ions $ThCl^+_3$, $ThCl^+_2$, and $ThCl^+$ show a larger and more nearly correct temperature dependence than the parent ion $ThCl^+_4$. Results are compared with those of other thorium and uranium halides.

37354 **Bond-selected bimolecular chemistry: $H+HOD(4\nu_{OH}) \rightarrow OD+H_2$.** Sinha, A. (Department of Chemistry, University of Wisconsin-Madison, Madison, Wisconsin 53706 (USA)); Hsiao, M.C.; Crim, F.F. *Journal of Chemical Physics (USA)*, 92(10): 6333-6335 (15 May 1990).

The reaction of HOD containing four quanta of O–H bond stretching vibration with H atoms produces OD fragments almost exclusively. Vibrational overtone excitation prepares $HOD(4\nu_{OH})$ that reacts with H atoms formed in a microwave discharge. The endothermic reaction of water with hydrogen atoms does not occur for ground vibrational state water but proceeds at roughly the gas kinetic collision rate for the vibrationally excited molecule. The production of OD fragments from $HOD(4\nu_{OH})$ in the reaction is at least two orders of magnitude more efficient than the production of OH, indicating very selective reaction of the vibrationally excited bond.

37355 **Some observations of the effects of high pressures and temperatures on the stability of $YBa_2Cu_3O_{7-x}$.** Williams, R.K. (Oak Ridge National Laboratory, P. O. Box 2008, Oak Ridge, Tennessee 37831 (USA)); Alexander, K.B.; Brynestad, J.; Henson, T.J.; Kroeger, D.M.; Lindemer, T.B.; Marsh, G.C.; Scarbrough, J.O. *Journal of Applied Physics (USA)*, 67(11): 6934-6939 (1 Jun 1990). DOE Contract AC05-84OR21400.

Hot isostatic pressing and heat treatments in high-pressure oxygen were used to study the effect of pressure on the stability of $YBa_2Cu_3O_{7-x}$. At 875 °C the compound decomposes at an oxygen pressure of about 7 bars. The decomposition involves formation of $Y_2BaCu_3O_5$ and a Ba-Cu oxide phase. Formation of the latter phase involves additional oxidation because this phase can contain as many as 1.5 oxygen atoms per barium atom. The decomposition can most simply be visualized by considering the chemical reaction $2(YBa_2Cu_3O_{7-x}) + (1)/(4)\ +x-y/2)O_2 \rightarrow Y_2BaCuO_5 + Ba_3Cu_5O_{9.5-y}$. Encapsulated samples also decompose during hot isostatic pressing, but the process appears to

be more complex. The compound $YBa_2Cu_4O_8$ was detected in addition to the two products observed in oxygen-treated samples. The reaction above, with $YBa_2Cu_3O_{7-x}$ serving as an oxygen source, aids in understanding the microstructural observations for encapsulated samples. Decomposition can be completely reversed by annealing in air for 20 h at 875 °C.

37356 Vibrational population lifetimes of polyalkenes in liquid solution. Graener, H. (Universitaet Bayreuth (West Germany)); Ye, T.Q.; Laubereau, A. *Journal of Physical Chemistry (USA)*, 93(20): 7044-7047 (5 Oct 1989).

By use of double-resonance spectroscopy with intense tunable picosecond pulses in the infrared, vibrational energy transfer is investigated in the CH-stretching region of some polyalkenes. Rapid energy redistribution with time constant < 5 ps and lifetimes T_1 = 17-36 ps are reported. A dominant role of the CH_3 groups for the population decay is suggested by the experimental data.

37357 Dissociation dynamics and multiphoton ionization mechanism of ammonia clusters. Misaizu, F. (Institute for Molecular Science, Okazaki (Japan)); Houston, P.L.; Nishi, N.; Shinohara, H.; Kondow, T.; Kinoshita, M. *Journal of Physical Chemistry (USA)*, 93(20): 7041-7044 (5 Oct 1989).

Two-color, two-photon ionization of ammonia has been used to investigate the ionization and dissociation mechanisms of ammonia clusters. By observing the ion signals in a reflectron time-of-flight mass spectrometer as a function of the delay time between the two laser pulses, it is found that the lifetime of the intermediate to formation of $(NH_3)_2H^+$ and higher mass cluster ions is at least 500 times longer than that to formation of NH_4^+ and $(NH_3)_2^+$. Similar results are found for deuterated ammonia. The intermediate is formed by one-photon excitation in the energy range accessing the $A\,^1A_2$ state of ammonia. This observation confirms that the mechanism of ionization of the dimer in this energy region is two-photon ionization followed by the rapid intracluster proton-transfer reaction $(NH_3)_2^+ \rightarrow NH_4^+ + NH_2$. The mechanism for ionization of larger clusters is discussed.

37358 Search for Urbach tails in the optical absorption spectra of solvated electrons in alcohols and water. Houee-Levin, C. (Universite de Sherbrooke, Quebec (Canada)); Tannous, C.; Jay-Gerin, J.P. *Journal of Physical Chemistry (USA)*, 93(20): 7074-7077 (5 Oct 1989).

The high-energy side of the optical absorption spectra of solvated electrons in several liquid alcohols and water has been analyzed for the first time within an Urbach tail scheme, assuming direct bound-to-continuum transitions. For all the studied alcohols and water, the solvated electron absorbance coefficients, taken from experimental data in the literature, vary exponentially with photon energy. In the case of alcohols, the semilogarithmic plots of the absorbance vs energy have a common intersection independent of temperature, whereas in water, the slops of these straight lines do not vary with temperature. Assuming the validity of the Urbach tail scheme, we have extracted the parameters which characterize the structural and thermal components of the disorder. We conclude that, in alcohols, thermal disorder is the main component, whereas in water, the effect of structural disorder dominates.

37359 Role of specific solvation in the fluorescence sensitivity of 1,8-ANS to water. Ebbesen, T.W. (Univ. of Notre Dame, IN (USA)); Ghiron, C.A. *Journal of Physical Chemistry (USA)*, 93(20): 7139-7143 (5 Oct 1989).

The excited-state properties of 1,8-anilinonaphthalenesulfonate (1,8-ANS) were investigated in binary water-ethanol solutions by means of picosecond and nanosecond laser flash photolysis and fluorescence measurements. The yield of the excited singlet state S_1, with absorbance maxima at ca. 450 and 690 nm, is independent of the ethanol content in the measured range (up to 40 vol%). Furthermore, S_1 does not ionize. Photoionization only occurs biphotonically. The yield of the triplet state of 1,8-ANS, with absorbance maxima at ca. 440 and 610 nm, decreases by 1 order of magnitude on going from pure ethanol to pure water. The fluorescence dependence on the water content is analyzed in terms of specific solute-solvent interactions with the Perrin equation.

37360 Vibrational pressure tuning spectroscopy of the polymethylene chain. 1. Various n-alkanes from C_8H_{18} to $C_{36}H_{74}$. Ley, W.W. (Univ. of Illinois, Urbana (USA)); Drickamer, H.G. *Journal of Physical Chemistry (USA)*, 93(20): 7257-7261 (5 Oct 1989).

In this paper, we present the effect of pressure on the vibrational spectra of a series of 11 crystalline paraffin hydrocarbons from n-C_8H_{18} to n-$C_{36}H_{74}$ plus n-C_8D_{18} and a few branched-chain compounds. The focus is on the increase in intensity of the CH_2 wagging and C-C stretching vibrations with pressure. The sum of the intensities increases in a manner that depends primarily on chain length. The distribution between the two vibrations depends on the crystal structure. The results imply that the primary event is an increase in the wagging vibration intensity due to increased intermolecular coupling. This intensity is redistributed to the C-C stretching vibration via some lattice mode (phonon-assisted coupling or phonon-assisted resonance). This resonance is most efficient for the orthorhombic structure with 4 molecules/unit cell and least efficient for the triclinic structure with 1 molecule/unit cell. For n-$C_{30}H_{62}$ and n-$C_{36}H_{74}$, which have a monoclinic structure with 2 molecules/unit cell, the behavior is intermediate.

37361 Vibrational pressure tuning spectroscopy of the polymethylene chain. 2. Various polyethylenes. Ley, W.W. (Univ. of Illinois, Urbana (USA)); Drickamer, H.G. *Journal of Physical Chemistry (USA)*, 93(20): 7262-7265 (5 Oct 1989).

In this paper, the authors present the effect of pressure on the vibrational spectra of a series of six polyethylenes of varying molecular weight and crystallinity. As in part 1 of this study, the focus is on the increase in intensity of the CH_2 wagging and C-C stretching vibrations with pressure. It is demonstrated that the intensities of the CH_2 wag and C-C stretch increase with pressure and that the C-C stretch borrows intensity from the CH_2 wag to the extent of overwhelming it. The results imply that the primary event is an increase in the wagging vibration intensity due to increased intermolecular coupling. This intensity is redistributed to the C-C stretching vibration via some lattice mode (phonon-assisted coupling). This coupling is much more efficient for the polyethylenes than the linear hydrocarbons studied in part 1 primarily due to the very small difference in energy between the two peaks.

37362 Dynamics of classical systems based on the principle of stationary action. Banerjee, A. (Theoretical Chemistry Group, Idaho National Engineering Laboratory, EG&G Idaho, Inc., P.O. Box 1625, Idaho Falls, Idaho 83415-2208 (USA)— Department of Chemistry, University of Utah, Salt Lake City, Utah 84112 (USA)); Adams, N.P. *Journal of Chemical Physics (USA)*, 92(12): 7330-7339 (15 Jun 1990). DOE Contract AC07-76ID01570.

Dynamics of classical systems often involve finding a path of evolution of the system between chosen initial and final configurations such as reactant and product states. We develop a method for calculating the dynamics of such classical systems posed as boundary value (configurations) problems. This method is based on recasting the principle of stationary action into a computationally tractable form which can be applied to a wide variety of boundary problems. We demonstrate that a path of minimum action does not always exist except for a short enough path. However, saddle points of the action can reveal interesting dynamical pathways. We give examples from particle mechanics and applications to reaction mechanisms for the $H+H_2 \rightarrow H_2+H$ reaction.

37363 The intramolecular kinetic isotope effect for the reaction $O(^3P)$+HD. Robie, D.C. (Department of Chemistry (M/C 111), University of Illinois at Chicago, Chicago, Illinois 60680 (USA)); Arepalli, S.; Presser, N.; Kitsopoulos, T.; Gordon, R.J. *Journal of Chemical Physics (USA)*, 92(12): 7382-7393 (15 Jun 1990). DOE Contract FG02-88ER13827.

The branching ratio for the reaction $O(^3P)$+HD to produce OH and OD was measured over the temperature range 339–500 K using a discharge-flow reactor. The OH and OD products were detected using laser-induced fluorescence under steady-state conditions. In order to determine the relative concentrations of OH and OD produced in this reaction, calibration runs were performed using the reactions of $O(^3P)+H_2$ and D_2 to produce known relative amounts of the same species. Kinetic modeling showed that secondary reactions and the production of vibrationally excited OD did not affect the measured branching ratio. We found that the OH/OD

ratio increased rapidly with decreasing temperature, in qualitative agreement with theory, showing that the reaction is dominated by tunneling below 400 K. At the lowest temperatures, the observed branching ratio is larger than predicted. The reason for this discrepancy is not known.

37364 Diffusion in supercooled liquids via normal mode analysis. Madan, B. (Department of Chemistry, Boston University, Boston, Massachusetts 02215 (US)); Keyes, T.; Seeley, G. *Journal of Chemical Physics (USA)*, 92(12): 7565-7569 (15 Jun 1990).

A theory is developed for diffusion in supercooled liquids. The viewpoint taken is that the dynamics of system, represented by a point in configuration space, consists of long sojourns in the vicinity of the local minima of the total potential, interrupted by relatively infrequent barrier crossings to adjacent minima. An equation due to Zwanzig, plus a new relation for the hopping rate among the local minima, are combined in a theory for the self-diffusion constant *D*. All the quantities entering the two equations are shown to be derivable from the configuration-averaged densities of vibrational states, $\langle \rho(\omega) \rangle$, introduced by us previously; the contribution of unstable modes plays a crucial role. Solution of the coupled equations reveals the existence of a critical temperature below which *D* vanishes. The theory is in excellent agreement with molecular dynamics values for *D*, over a wide temperature range in which *D* displays activated behavior, in Lennard-Jones argon at a reduced density of unity.

37365 Location of melting point at 300 K of nitrogen by Monte Carlo simulation. Meijer, E.J. (FOM Institute for Atomic and Molecular Physics, Kruislaan 407, 1098 SJ Amsterdam, (The Netherlands)); Frenkel, D.; LeSar, R.A.; Ladd, A.J.C. *Journal of Chemical Physics (USA)*, 92(12): 7570-7575 (15 Jun 1990). DOE Contract W-7405-ENG-48.

We present an accurate new method to compute absolute free energies of molecular solids by computer simulations. As a first application, we computed the thermodynamic phase transition between the fluid phase and the orientational disordered solid β phase of nitrogen at 300 K, using a well tested pair potential. The computed coexistence pressure and the volume change coincides within the error margins with the experimental values. The coexistence volume differed by 2% from the experimental value. To our knowledge these results constitutes the first numerical calculation of the thermodynamic stability for a model of a realistic molecular solid.

37366 A comparative kinetic study of xenon adsorption on a flat Pt(111) and stepped Pt(557) and Pt(112) surfaces. Siddiqui, H.R. (Surface Science Center, Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania 15260 (US)); Chen, P.J.; Guo, X.; Yates, J.T. Jr. *Journal of Chemical Physics (USA)*, 92(12): 7690-7699 (15 Jun 1990).

The adsorption and desorption kinetics for Xe on three Pt single crystalline surfaces have been measured using threshold temperature programmed desorption measurements. It has been found that the first-order desorption kinetic parameters at zero coverage for Xe on Pt(111) (E^0_d =5.73±0.50 kcal/mol; ν^0_d=$10^{12.5\pm0.9}$ s^{-1}) are in excellent agreement with measurements made by a modulated molecular beam method [E^0_d =5.65±0.35 kcal/mol; ν^0_d=$10^{12.1}$ s^{-1}]. The presence of step defect sites of varying density on Pt(557) (1/6 defects) and on Pt(112) (1/3 defects) is shown to have a marked influence on Xe desorption kinetics, producing larger values of $E^0_d \cong 8.5$–8.7 kcal/mol and larger values of $\nu^0_d \cong 10^{14}$ s^{-1} compared to Pt(111). In addition, for Pt(111), slight attractive Xe–Xe interactions are observed, whereas for Xe adsorption on step sites, repulsive Xe–Xe interactions are observed as the steps fill. Xe adsorption kinetics on Pt(111) at 87 K are consistent with an island growth mechanism. In contrast, on Pt(557) and Pt(112), the adsorption process does not seem to produce island growth on the terraces. These results, taken together, show that using Xe, defect sites on metals may be probed effectively with adsorption and desorption kinetic methods.

4004 Electrochemistry

Refer also to citation(s) 37002, 37299, 38007

4005 Photochemistry

Refer also to citation(s) 36839, 36856, 37306, 37323, 37328, 37329, 37619, 37720, 38066

4006 Radiation Chemistry

Refer also to citation(s) 36945

37367 (CNIC–00124) **The irradiation effects on extraction properties and physical data of 30% TRPO-kerosene.** Zheng Hualing (Beijing Inst. of Nuclear Engineering, BJ (China)); Zhou Shunli; Chen Shuming; Jiao Rongzhou; Wang Shouzhong; Fan Shiguo; Liu Bingren. China Nuclear Information Centre, Beijing, BJ (China). Dec 1987. 10p. (In Chinese). (BINE–0004). Order Number DE90631085. Available from NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The γ-irradiation does effects in extraction and re-extraction properties (U,Pu,Am,Eu,Pm), physical data (density, viscosity, diopter, transmissivity of ultraviolet ray), have been determined. The composition and structure of irradiated TRPO were studied by infra-red spectrometry. Results show that polymer, alkyl phosphine acid, nitroso-compound, nitro-compound, carbonyl compound can be shown in the infra-red spectrometry. A simple washing with 5% Na_2CO_3-1mol/L HNO_3-H_2O can scrub out main irradiation products from solvent phase. TRPO possesses excellent irradiation stability. It can be used to treat high level liquid waste and some transuranium targets.

37368 (CNIC–00238) **The photochemical behaviour of plutonium (IV).** Zhou Zhihong (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy); Zhang Xianye; Hu Jingxin; Duan Yunfu. China Nuclear Information Centre, Beijing, BJ (China). 1988. 8p. (In Chinese). (IAE–0050). Order Number DE90631086. Available from NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

The effects of concentration of H^+ and NO^{3-} on the photochemical behaviour of Pu(IV) in perchloric acid solution (ionic strength : 3) have been investigated. The results show that the photochemical oxidation of Pu(IV) to Pu(VI) is obviously promoted by nitrate ion. The research of thermo-disproportionation of Pu(IV) in perchloric acid solution (ionic strength : 3) at 63 deg C and irradiation of ultraviolet beam in same experimental condition have been finished. The results show that the light irradiation with ultraviolet beam promote the disproportionation of Pu(IV), ratioes of reaction concentration quotient ($[Pu(III)]^2$ $[Pu(IV)]/[Pu(IV)]^3$) are determined as 3.25, 0.30, 0.094 and 0.054 at $[H^+]$ equal to 1.0, 1.5, 2.0, and 3.0 mol/L. The effects of CH_3OH, C_2H_5OH, UO_2^{2+} and Fe^{3+} on the photochemical behaviour of Pu(IV) in nitrat solution are also studied. The results show that the Pu(IV) oxidation to Pu(VI) is inhibited by ferric ion, quantity of Pu(VI) can be dicreased from >80% to <10% if the concentration of ferric ion $\geq$ 0.038 mol/L. The probable reason of inhibition of Pu(IV) oxidation to Pu(VI) by ferric ion has been discussed.

37369 (EP-SESI-RA–1988) **Studies on the irradiated solids.** Lesueur, D. (CEA, 75 - Paris (FR)). Ecole Polytechnique, 91 - Palaiseau (France). 1988. 18p. (In French). Order Number DE90500848. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the Irradiated Solids laboratory (Polytechnic School, France), is presented. The Laboratory activities concern the investigations on disordered solids (chemical or structural disorder). The disorder itself, its effects on the material physical properties and the particle-matter interactions, are investigated. The research works are performed in the following fields: solid state physics, irradiation and stoechiometric defects, and nuclear materials. The scientific reviews, the congress communications and the thesis are listed.

37370 A time-resolved Raman study of the reaction of OH radicals with p-phenylenediamine. Sun, Q. (Univ. of Notre Dame, IN (USA)); Tripathi, G.N.R.; Schuler, R.H. *Journal of Physical Chemistry (USA)*, 94(5): 2216-2217 (8 Mar 1990).

In a previous study of the reaction of OH with aromatic diamines the absorption spectrum attributed to the OH adducts was reported to be virtually identical with that of the radical cations, differing only

in intensity. Here we apply pulse radiolysis methods with time-resolved resonance Raman detection to examine the intermediates formed in the OH oxidation of p-phenylenediamine. These studies show that in neutral and basic solution the OH adducts, if formed, have a very short lifetime, that the absorption spectrum previously assigned to the OH adduct is, in fact, that of the radical cation, and that this radical cations does not protonate in moderately acidic solutions.

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 37327, 37334, 37342, 37368

4008 Combustion, Pyrolysis, and High-Temperature Chemistry

Refer also to citation(s) 36802, 37142, 37390, 37397, 37399, 37549

37371 (DOE/AL/43058–T3) **Investigation of particulate formation during diesel spray combustion: Technical progress quarterly report, March 1–May 31, 1990.** United Technologies Research Center, East Hartford, CT (USA). [1990]. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-87AL43058. Order Number DE90012682. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objective of the contract is to conduct an experimental and analytical research program to investigate strategies for using coherent anti-Stokes Raman scattering (CARS) laser diagnostic techniques for detecting the degree of fuel pyrolysis and determining fuel-air ratio. Smoke and NO_x production rates depend in a complex way on the local temperature, the evaporation of the diesel spray, the local fuel-air ratio, and the pyrolysis history of the fuel. Furthering the ability of CARS to provide more of this information may give engine designers more insight into the combustion process and allow them to create engines which produce fewer particulates or lower amounts of NO_x. Controlling the production rates is preferable to processing emissions. If they cannot both be suppressed simultaneously, adjusting the tradeoff between producing particulates or NO_x may be helpful if an exhaust processing method is available for one of them.

37372 **Hydroxyl radical concentration measurements in a turbulent flow reactor using a high temperature laser induced fluorescence probe.** Linteris, G.T. (Dept. of Mechanical and Aerospace Engineering, Princeton Univ., Princeton, NJ (US)); Brezinsky, K.; Dryer, F.L. pp. 3.1-3.4 of Chemical and physical processes in combustion. Combustion Institute, Pittsburgh, PA (USA) (1989). (CONF-8910124–: 22. chemical and physical processes in combustion fall technical meeting, Albany, NY (USA), 30 Oct - 1 nov 1989).

The authors have attempted to extend the capabilities of the turbulent flow reactor to include measurement of trace radical species. Because of the dilute operation of the flow reactor and the temperature of operation (800–1300 K), the expected radical concentrations are low relative to flames. For example, peak hydroxyl radical concentrations in the flow reactor are expected to be from three to five orders of magnitude lower than in typical hydrocarbon flames. To provide the necessary species concentration data as a function of extent of reaction, the present configuration of the atmospheric pressure reactor dictates that the species sampling system be capable of measurements at any location along the longitudinal axis of the one meter duct. The heaters and insulation necessary for the high temperature operation of the reactor, however, severely restrict the physical access to the interior of the reactor. These constraints of low concentration and axial access, together with the high temperature reactive environment inside the flow reactor create difficult experimental challenges. To overcome these challenges and measure, initially, hydroxyl radical concentration in the reactor, the laboratory has developed a unique 180° laser induced fluorescence probe. This paper describes the probe and the associated laser and detection systems, and presents measured OH concentration data in a moist CO oxidation in the flow reactor provided by the fluorescence probe.

42 ENGINEERING

4202 Facilities, Equipment, and Techniques

Refer also to citation(s) 36697, 36749, 36751, 36752, 36775, 36804, 36806, 37203, 37558, 38313, 38319, 38331

37373 (CONF-9008103–1) **Stiffness control of teleoperators with redundant, dissimilar kinematics.** Jansen, J.F.; Kress, R.; Babcock, S.; Hamel, W. Oak Ridge National Lab., TN (USA). [1990]. 5p. Sponsored by U.S. Department of Defense; U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From IEEE international conference on system engineering; Pittsburg, PA (USA); 9-11 Aug 1990. Order Number DE90011642. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper addresses the problem of dissimilar kinematic teleoperator systems. Since the next generation of teleoperator systems will likely include dissimilar kinematics, a workable control scheme compatible with modern microprocessor computing capability is needed. The control scheme presented in this paper incorporates the work and ideas of numerous researchers over the past 40 years. Due to the ongoing nature of this research and limited space allowed, only a brief summary will be given concerning the overall control strategy; instead, the master controller and orientation representation for both the master and slave will be the main focus of this paper. 10 refs., 1 fig.

37374 (DOE/CE/90029–2) **Theoretical studies on the role of transition in determining friction and heat transfer in smooth and rough passages: Final report.** Obot, N.T. (Clarkson Univ., Potsdam, NY (USA). Fluid Mechanics, Heat and Mass Transfer Lab.); Esen, E.B.; Rabas, T.J. Clarkson Univ., Potsdam, NY (USA). Fluid Mechanics, Heat and Mass Transfer Lab. Apr 1990. 165p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FG02-89CE90029. Order Number DE90009987. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

It has been established that transition determines the attainable friction and heat transfer in smooth and rough passages. According to the proposed law of corresponding states for friction, different types of roughness exhibit the same general behavior for friction at the same reduced conditions. This is also true of different types of smooth passages. It has been fully demonstrated that, in rough passages, the marked increases in friction factor are intimately associated with early transition and that, under reduced similarity conditions, the friction factors are considerably lower than those deduced from the familiar f vs. Re plots. For all smooth or rough passages, the simple rule for heat transfer amounts to this: the lower the critical Reynolds number for transition, the greater the value for the average heat transfer coefficient. Consequently, for a given Reynolds number based on the hydraulic diameter, triangular passages can be expected to give heat transfer coefficients that are significantly higher than for circular, rectangular or annular tubes. For smooth and enhanced passages of complex shapes, it appears that heat transfer coefficients can be calculated accurately from the smooth circular tube relations, provided the critical Reynolds number is known. 61 refs., 25 figs., 1 tab.

37375 (DOE/OR–884/R2) **DOE/NE University Program in robotics for advanced reactors: Program plan, FY 1990–FY 1994.** Sweeney, F.J. (Oak Ridge National Lab., TN (USA)); Gonzalez, R.C.; Trivedi, M.M.; Tesar, D.; Tulenko, J.S.; Wehe, D.K. Oak Ridge National Lab., TN (USA). May 1990. 138p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. (ORNL/M–1140). Order Number DE90011293. Available from NTIS, PC A07/MF A01; OSTI; INIS; GPO Dep.

The US Department of Energy has provided support to four universities and the Oak Ridge National Laboratory in order to pursue research leading to the development and deployment of advanced robotic systems capable of performing tasks that are hazardous to humans, that generate significant occupational radiation exposure, and/or whose execution times can be reduced if performed by an automated system. The goal is to develop a generation of advanced robotic systems capable of economically performing surveillance, maintenance, and repair tasks in nuclear facilities and

other hazardous environments. The approach to achieving the program objective is a transition from teleoperation to the capability of autonomous operation within three successive generations of robotic systems. The strategy adopted in order to achieve the program goals in an efficient and timely manner consists in utilizing, and advancing where required, state-of-the-art robotics technology through close interaction between the universities and the manufacturers and operators of nuclear power plants. There is a potentially broad range of applications for the robotic systems developed in the course of this project. Therefore, it is expected that efforts to obtain additional support from other agencies, e.g., DOD and NASA, will be successful. Areas of cooperation with other nations (e.g., Japan, France, Germany) are being explored. This Program features a unique teaming arrangement among the Universities of Florida, Michigan, Tennessee, Texas, and the Oak Ridge National Laboratory, and their industrial partners, Odetics, Gulf State Utilities, Florida Power and Light Company, Remotec, and Telerobotics International.

37376 (KEK–89-13, pp. 107-110) **Large-load cryostat for UTS.** Hosoyama, Kenji (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1989. (In Japanese). (CONF-8903201–: 2. KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons, Tsukuba (Japan), 11 Mar 1989). In *The 2nd KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons.* Order Number DE90760025. Available from NTIS (US Sales Only), PC A07/MF A01.

The report describes a $^3He/^4He$ refrigerating system with a working temperature of 0.6 K and refrigerating capacity of 3 W to be used as a major component of a very low temperature large-load cryostat. The refrigerating system has a capacity about three times as large as the largest refrigerators currently available whose capacity is about 1 W in this temperature range. In addition, it should be able to operate stably for a long time. To achieve this, the present refrigerating system uses the combination of a ^3He and ^4He refrigerators to form a basic refrigerating cycle. The ^4He refrigerator is conventional 4K-level equipment, which is combined with a pre-refrigerator and ^3He refrigerator which produce superfluid helium by depressurize the liquid ^4He generated by the former refrigerator. For the ^3He refrigerator and pre-refrigerator to have a capacity of 3 W and 5 W, respectively, the C0 and C1 pumps should have a capacity of about 0.25 g/s. For them to achieve a working temperature is 0.6 K and 1.2 K, their working pressure should be 0.54 Torr and 0.62 Torr, respectively. Thus, pumps with a large capacity of about 3000 l/s and 1600 l/s, respectively, are required for pumping at room temperature. (N.K.).

37377 (LA-UR–90-1847) **Sampling plans to find faulty waste storage drums.** Beckman, R.J.; McKay, M.D. Los Alamos National Lab., NM (USA). [1990]. 22p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-9008101–1: American Statistical Society, Anaheim, CA (USA), 6-9 Aug 1990). Order Number DE90011998. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In environmental surveillance work, one is often faced with the task of determining by a random sample that hazardous waste is stored safely. In many cases such waste is kept in drums which are accumulated at various sites, and some of these sites are thought to have a more deleterious effect on the drums than other sites. In this paper, "knowledge" of the sites is used to develop sampling plans which increase the probability of finding faulty drums. An exchange algorithm to determine the sample sizes is given, and the influence of the prior "knowledge" on these sample sizes is investigated.

37378 (SAND–90-0236C) **A virtual sensor approach to robot kinematic identification: Theory and experimental implementation.** Muir, P.F. Sandia National Labs., Albuquerque, NM (USA). [1990]. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9008103–2: IEEE international conference on system engineering, Pittsburg, PA (USA), 9-11 Aug 1990). Order Number DE90012186. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Kinematic parameter estimates are required for the implementation of robot servo-control algorithms. The goal of robot kinematic identification is to accurately estimate robot kinematic parameters from experimental data. A system for identifying robot kinematics is developed which applies a novel virtual sensor approach to parameter estimation. The system incorporates the uncertainty of experimental measurements through the introduction of computationally simple variance matrix approximations. A novel line-fitting procedure which requires no additional sensors or accurately machined components is devised for experimentally comparing the parameter estimates with the robot design parameters. Experimental data is acquire from and the kinematic parameters are estimated for an Adept II robot manipulator using a commercially available visual three-dimensional position sensor. 8 refs., 3 figs.

37379 (SAND–90-0366) **Literature review of cask exterior surface contamination with application to a nuclear repository.** Adams, K.G. Sandia National Labs., Albuquerque, NM (USA). Apr 1990. 22p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC04-76DP00789. Order Number DE90011781. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The characteristics of transportation cask surface contamination and the "weeping" phenomenon are reviewed. In addition, literature that pertains to the possible impact of surface contamination on repository operations is reviewed. This report consists of commentary on and rather extensive excerpts from the published literature on cask surface contamination that may have a bearing on repository risk assessment. In addition, estimates are made of the quantity of contamination that might be present on a cask. These estimates are used to calculate the direct exposure rates to personnel located at several distances from the cask. 15 refs., 15 tabs.

37380 (SAND–90-0783C) **Selecting appropriate test targets for portal weapons detection.** Murray, D.W. Sandia National Labs., Albuquerque, NM (USA). [1990]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9007106–3: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90013000. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Adjusting a portal metal detector for weapons detection must be performed with great care. Set the sensitivity too high and the false rejection rate for personnel passing through the portal will slow traffic to everyone's annoyance. Set the sensitivity too low and run the risk that the machine will allow some of today's small handguns to pass with impunity. Because many of the modern handguns are so small the difference between a sensitivity setting that is too high and one that is too low is quite small. In order to find that fine line between too much sensitivity and too little, a set of test targets must be selected that represent the widest possible spectrum of weapons. The test set must not only be representative of small guns but also reflect the wide variety of metals that are used to manufacture today's weapons.

37381 (SAND–90-1272C) **Monocular 3D vision for a robot assembly environment.** Ray, L.P. Sandia National Labs., Albuquerque, NM (USA). [1990]. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900894–1: IEEE international conference on systems engineering, Cincinnati, OH (USA), Aug 1990). Order Number DE90010824. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The three-dimensional position and orientation of objects is estimated from one or more monocular images. The identities of the objects are known, and geometric models are assumed to be available. Images are interpreted, finding correspondence between linear features extracted from sensor data and modeled object features, by searching an interpretation tree built using prior position estimates. Object positions are updated by maximum-likelihood estimation. Position estimation results from an implemented system are presented, demonstrating location of partially occluded objects in a cluttered scene. 16 refs.

37382 (SAND–90-1292C) **Integration of model-based and sensor-based control for a two-link flexible robot arm.** Feddema, J.T.; Eisler, G.R.; Segalman, D.J. Sandia National Labs.,

Albuquerque, NM (USA). [1990]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900894–2: IEEE international conference on systems engineering, Cincinnati, OH (USA), Aug 1990). Order Number DE90012183. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper analyzes the experimental results of model-based and sensor-based control strategies for a two-link flexible, planar, robot arm. An off-line optimization determines a minimum time, straight line tip trajectory which stays within the torque constraints of the motors and ends in a quiescent state, i.e. no vibrational transients. An efficient finite-element model is used in the optimization to approximate the flexible arm dynamics. Control schemes testes include an open loop torque profile, a closed loop Proportional-Derivative (PD) joint controller, and a feedforward controller. This last scheme uses the torque profile created from the optimization, along with PD feedback of the joint angles and proportional feedback of the strain gages, to correct for errors in the model. The results show that the best performance is achieved with this feedforward approach. 10 refs., 10 figs.

37383 (SAND–90-1683C) **Adsorption of spent fuel storage pool contaminants into metal surfaces.** Reaves, K. (Missouri Univ., Columbia, MO (USA)); Kunze, J.; Lu, Kang; Bennett, P.C. Sandia National Labs., Albuquerque, NM (USA). [1990]. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900608–38: American Nuclear Society annual meeting, Nashville, TN (USA), 10-14 Jun 1990). Order Number DE90013069. Available from NTIS, PC A02/MF A01 - OSTI.

Shipping casks, after being submerged in spent fuel pools for the purpose of loading or unloading fuel, resist complete removal of the adsorbed contamination. To systematically study the mechanisms involved, 122 metal surface samples were immersed in the spent fuel storage pool of the Callaway Power Plant for periods of 7 to 30 days. After being removed from the pool, all samples were washed and wiped (with cloth) using demineralized water. They were then gamma counted for absolute activity, by using Eu-152 as an energy efficiency calibrator, applied uniformly to unexposed sample surfaces. Swipes were taken after each of 3 days of such environmental conditioning. Following this conditioning, selected samples were again counted to determine absolute contamination remaining on the samples. 2 refs., 1 tab.

37384 **Use of fiber optic equipment for security.** Schwalm, R.W. (Los Alamos National Lab., Los Alamos, NM (US)). pp. 79-82 of Proceedings of the 1988 carnahan conference on security technology: Electronic crime countermeasures. DeVore, R.W. University of Kentucky, Lexington, KY (USA) (1988). (CONF-880584–: Carnahan conference on security technology: electronic crime countermeasures, Lexington, KY (USA), 10-12 May 1988).

The use of fiber optic equipment in the field of security is becoming widely accepted. Great strides made in the development of splitters, couplers, multiplexers, switches, and sensors developed to expand the capabilities of the optic cable have made its application in more demand. Upgrades have provided systems with noise free video transmission in both black and white and in color. Ground loop problems have been lessened. The system using fiber optics for video transmission also transmits audio for the purpose of monitoring areas under surveillance.

37385 **Hazard rate for a two-channel protective system subject to a high demand rate.** Oliveira, L.F. (Brookhaven National Lab., Upton, NY (USA)); Youngblood, R.; Melo, P.F.F. pp. 367-372 of Transactions of the 10th international conference on structural mechanics in reactor technology. Hadjian, A.H. American Association for Structural Mechanics in Reactor Technology, Los Angeles, CA (USA) (1989). (CONF-890855–: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), Anaheim, CA (USA), 14-18 Aug 1989).

A basic figure of merit associated with a protective system for an industrial plant is the number of accidents expected to occur in the plant within a given period of time, with the system installed. By definition, in a plant equipped with a protective system, an accident can only happen if an initiating event (a demand) occurs while the protective system is unavailable, that is, while it is in one of its possible failed states. This means that the hazard rate or accident frequency depends on the demand rate and on the unavailability of the protective systems. It has long been recognized that the demand rate influences the unavailability of the protective system, and practical expressions incorporating that effect have been developed for single-channel (Lees, 1982) and multi-channel (Kumamoto and Henley 1978) protective systems. The effect has also been incorporated into a Markovian treatment of a plant protection system (Papazoglou and Cho, 1985). In a previous paper (Oliveira and Netto, 1987) a Markovian approach was used to derive analytical expressions for the evaluation of the plant hazard rate for a single-channel protective system, properly accounting for the effects of the demand and the repair rates. In this paper the authors present an extension of that model to the case of a plant equipped with a two-channel protective system.

4204 Heat Transfer and Fluid Flow

Refer also to citation(s) 36802, 36859, 37152, 37499, 38120

37386 (DOE/ER/13328–T1) **Transport characteristics of concentrated slurries: Final technical report.** Acrivos, A. (City Coll., New York, NY (USA)). Stanford Univ., CA (USA). 7 Sep 1988. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-85ER13328. Order Number DE90012428. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

During the 3-year period covered by this grant, April 1, 1985 to March 31, 1988 the following 3 projects, pertaining to the flow characteristics of concentrated slurries, were investigated both theoretically and experimentally. 10 refs.

37387 (KEK–89-13, pp. 119-126) **Problems of thermal engineering in target cooling.** Kumada, Toshiaki (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1989. (In Japanese). (CONF-8903201–: 2. KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons, Tsukuba (Japan), 11 Mar 1989). In *The 2nd KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons.* Order Number DE90760025. Available from NTIS (US Sales Only), PC A07/MF A01.

The necessity of target cooling arises from the problem that the channel becomes narrow due to the strain caused by the temperature rise in a target, the temperature rises further, and the damage occurs, and the problem of radioactivity contamination in a cooling system by the excessive dissolution of target metal into water due to surface temperature rise. Usually, by flowing water around a circular column-shaped target to cool it, the target is maintained below a prescribed temperature. When the rate of heat generation within a target is not more than 10 kW, the division of the target for cooling is not required. However, when the rate of heat generation becomes larger, the surface heat flux of a target exceeds the limit heat flux, and the temperature rises rapidly or the problem of remarkably increasing strain as the target temperature exceeds the transition temperature causing phase transformation occurs. In this study, the case of cooling the target of tungsten alloy with water is supposed, and the approximate calculation of the surface heat flux of the target and the estimation of the temperature distribution in the target based on the report of ANL-83-14 (beam 500 MeV, 0.98 μA) were carried out. Under the beam condition at 1 GeV and 20 μA, the cooling while preventing surface boiling is feasible by forced convection heat transfer. (K.I.).

37388 (SAND–89-1301) **Developing convection above a finite horizontal surface.** Chu, T.Y. (Sandia National Labs., Albuquerque, NM (USA)). Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900803–1: 9. international heat transfer conference, Jerusalem (Israel), 26-31 Aug 1990). Order Number DE90002833. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The problem described – the initiation of convection above a suddenly heated horizontal surface of finite extent – is of interest to both the engineering and geophysical fields. The apparatus used in the described experiment consisted of an enclosure with a square planform. A heated strip, whose width was equal to one-fourth of

the length of a side of the enclosure, was centered on the lower inside surface of the enclosure. The top of the fluid layer was maintained at a constant temperature, and the depth of the layer was equal to the width of the heated strip. The flow field, heater surface temperature, and heat flux distribution were studied. Flow was observed to initiate near the edges of the heated strip as two convection cells. In time, the two cell boundaries merged into a central plume rising above the heated strip. The velocity field was found to be the most sensitive indicator of convection; surface temperature, the least. Despite the finite width of the heated strip and the finite depth of the layer, the initiation of convection appeared to readily conform to Howard's model of conduction layer instability developed for infinite layers. The average Rayleigh number for the critical conduction layer was 1120. 10 refs., 9 figs., 1 tab.

37389 **Infrared radiation of SF_6 and its application to gas-filled double-pane windows.** Reilly, S. (Lawrence Berkeley Lab., CA (USA)); Rubin, M.; Tuntomo, A.; Tien, C.L. *Experimental Heat Transfer (USA)*, 3(1): 65-80 (1990).

Interest in using sulfur hexafluoride (SF_6) as a gas-fill in multipane windows has raised questions concerning the calculation of heat transfer rates through such windows. The infrared absorption characteristics of this gas make the heat transfer analysis much more complicated. In order to account for the absorption effect, the authors measured the spectral absorptivity of several infrared-active bands of sulfur hexafluroide at low resolution and a temperature of 298 K. The authors correlated the spectral absorption data with Edwards exponential wide-band model and with the Elasser narrow-band model, and incorporated, the wide-band model into a one-dimensional, finite-element heat transfer model. The finite-element heat transfer model considered combined conduction and radiation effects in a double-pane window, and was used to evaluate the overall heat transfer coefficients of double-pane windows filled with SF_6, CO_2, or air. The numerical results show good agreement with the experimental results.

37390 **Stability of homogeneous-solid deflagration with two-phase flow in the reaction zone.** Margolis, S.B. (Sandia National Labs., Livermore, CA (USA). Combustion Research Facility); Williams, F.A. *Combustion and Flame (USA)*, 79(2): 199-213 (Feb 1990).

An asymptotic model is derived for the nonsteady, nonplanar deflagration of energetic solids, such as nitramines, that experience exothermic reactions in liquid layers at their surfaces. The analysis takes into account the role of interphase heat transfer and the relative motion of gas and liquid in the resulting two-phase region at the surface. A basic solution corresponding to steady, planar burning is obtained, and a linear stability analysis yields a neutral stability boundary beyond which the basic solutionis unstable to pulsating disturbances. In particular, it is found that stability of the basic solution is lost for sufficiently large values of the activation energy and/or sufficiently small values of the interphase heat transfer parameter. In the combined limit that the latter approaches infinity and a velocity-perturbation parameter, which accounts for two-phase viscous and Marangoni effects, approaches zero, the neutral stability boundary is the same as that encountered for separate-phase solid propellants with an intrusive gas flame.

37391 **Weakly nonlinear states as propagating fronts in convecting binary mixtures.** Fineberg, J. (Center for Nonlinear Dynamics and the Department of Physics, University of Texas, Austin, Texas 78712 (USA)); Steinberg, V.; Kolodner, P. *Physical Review, A (General Physics) (USA)*, 41(10): 5743-5746 (15 May 1990).

We present a picture of the weakly nonlinear time-dependent (blinking) traveling-wave state in the convection of binary mixtures as a propagating, spatially confined solution of coupled Landau-Ginzburg equations. Quantitative agreement with the measured slow oscillation frequency is found. In addition, a number of experimental observations regarding the blinking and confined states can be understood in this picture.

4205 Materials Testing

Refer also to citation(s) 36746, 36936, 36945, 37549

37392 (BNL-NUREG-43991) **Heat transfer between stratified liquids with bubbling across the interface.** Greene, G.A. (Brookhaven National Lab., Upton, NY (USA)); Chen, J.C.; Irvine, T.F. Jr. Brookhaven National Lab., Upton, NY (USA). [1990]. 6p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (CONF-900803-3: 9. international heat transfer conference, Jerusalem (Israel), 26-31 Aug 1990). Order Number DE90008579. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A situation that arises in the chemical metallurgical, and nuclear power industries is one in which two overlying immiscible liquids are stirred by gas bubbles rising across their interface. Due to the gas bubbling, there are three mixture configurations that may occur which depend primarily upon the physical and transport properties of the two liquids, and the droplet and bubble dynamics. These are the stratified, partially-mixed, and fully-mixed configurations. A model is presented for heat transfer between the liquids in the stratified state. A criterion for the onset of entrainment and a model for the rate of mass entrainment per bubble are also a predictive. These models are combined to develop a predictive capability for the heat transfer across the liquid-liquid interface in the partially-mixed and stratified regimes. 12 refs., 6 figs., 1 tab.

37393 (CONF-8911193-2) **Influence of thermal conditioning media on Charpy specimen test temperature.** Nanstad, R.K.; Swain, R.L.; Berggren, R.G. Oak Ridge National Lab., TN (USA). [1989]. 16p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From Symposium on Charpy impact test: factors and variables; Orlando, FL (USA); 8-9 Nov 1989. Order Number DE90012784. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The Charpy V-notch (CVN) impact test is used extensively for determining the toughness of structural materials. Research programs in many technologies concerned with structural integrity perform such testing to obtain Charpy energy vs temperature curves. American Society for Testing and Materials Method E 23 includes rather strict requirements regarding determination and control of specimen test temperature. It specifies minimum soaking times dependent on the use of liquids or gases as the medium for thermally conditioning the specimen. The method also requires that impact of the specimen occur within 5 s removal from the conditioning medium. It does not, however, provide guidance regarding choice of conditioning media. This investigation was primarily conducted to investigate the changes in specimen temperature which occur when water is used for thermal conditioning. A standard CVN impact specimen of low-alloy steel was instrumented with surface-mounted and embedded thermocouples. Dependent on the media used, the specimen was heated or cooled to selected temperatures in the range −100 to 100°C using cold nitrogen gas, heated air, acetone and dry ice, methanol and dry ice, heated oil, or heated water. After temperature stabilization, the specimen was removed from the conditioning medium while the temperatures were recorded four times per second from all thermocouples using a data acquisition system and a computer. The results show that evaporative cooling causes significant changes in the specimen temperatures when water is used for conditioning. Conditioning in the other media did not result in such significant changes. The results demonstrate that, even within the guidelines of E 23, significant test temperature changes can occur which may substantially affect the Charpy impact test results if water is used for temperature conditioning. 7 refs., 11 figs.

37394 (EGG-M-89196) **Field experience in using laser acoustic sensing for inspection.** Rodriguez, J.G.; Tow, D.M.; Barna, B.A. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1989]. 5p. Sponsored by National Aeronautics and Space Administration. DOE Contract AC07-76ID01570. (CONF-890770-12: 16. annual review of progress in quantitative nondestructive evaluation, Brunswick, ME (USA), 23-28 Jul 1989). Order Number DE90012954. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Research being performed to develop a viable noncontacting NDE technique for measuring the extent of bonding has led to the development of a laser sensor field system. The noncontacting laser sensor has been used to collect data from diffuse surfaces, such as the Thermal Protection System (TPS) tile on the space

shuttle orbiter. The bonded material gently excited with an acoustic signal, and the displacement is detected and related to the degree of bond. Controlled experiments in the laboratory have provided useful information on the dynamic response of TPS tiles. It has been shown that several candidate signatures are common to all the "pedigree tiles." This degree of consistency in the tile-SIP (strain isolation pad) dynamic response proves that an unbond can be detected for a known tile and established the basis for extending the analysis capability to arbitrary tiles for which there is not historical data. The field tests of the noncontacting laser acoustic sensor system, conducted at Kennedy Space Center (KSC), investigated the vibrational environment of the Orbiter Processing Facility (OPF) and its effect on the measurement and analysis techniques being developed. The data collected showed that for orbiter locations, such as the body flap and elevon, the data analysis scheme, and/or the sensor, will require modification to accommodate the ambient motion. Several methods have been identified for accomplishing this and a solution is seen as readily achievable. It was established that the tile response was similar to that observed in the laboratory. Of the most importance, however, is that the field environment will not affect the physics of the dynamic response that is related to bond condition. All of this information is fundamental to any future design and development of a prototype system. 2 refs., 3 figs.

37395 (VTT-TUTK–653) **Eddy current inspection at the nuclear power plants.** Lahdenperae, K. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Sep 1989. 90p. (In Finnish). Order Number DE90631385. Available from NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

This survey presents the possibilities of eddy current testing in nuclear power plants based on litterature and on the experiences of the Metals laboratory of the Technical Research Center of Finland from inservice inspections of nuclear power plants. The main emphasis is on eddy current testing of heat exhangers and especially on steam generators. Also descriptions of typical degradation mechanisms and recommended methods to detect and to evaluate such degradations are included. Finally the application of eddy current method to surface testing and especially to turbine blades and to threaded components is considered. Special attention is given to the sensitivity and the restrictions of eddy current testing due to material properties and geometry.

37396 Time-reversible equilibrium and nonequilibrium isothermal-isobaric simulations with centered-difference Stoermer algorithms. Holian, B.L. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (USA)); De Groot, A.J.; Hoover, W.G.; Hoover, C.G. *Physical Review, A (General Physics) (USA)*, 41(8): 4552-4553 (15 Apr 1990). DOE Contract W-7405-ENG-36.

We describe simple, stable, and economical numerical methods for implementing temperature and pressure controls in equilibrium and nonequilibrium Nose-Hoover dynamics. These methods substantially increase the efficiency of large-scale simulations.

4210 Combustion Systems

Refer also to citation(s) 37146

37397 Pulse combustion: The quantification of characteristic times. Keller, J.O. (Sandia National Labs., Livermore, CA (USA). Combustion Research Facility); Bramlette, T.T.; Westbrook, C.K.; Dec, J.E. *Combustion and Flame (USA)*, 79(2): 151-161 (Feb 1990).

Measurements of the total ignition delay time in a pulse combustor have been made for several chemical kinetic ignition delay times and several fluid dynamic mixing times. These measured total ignition delay times are compared with calculated values of the characteristic time for mixing and with calculated values for the homogeneous ignition delay time. A chemical kinetic model was used to calculate the homogeneous chemical kinetic ignition delay time for conditions typical of an operating pulse combustor. Similarly, a fluid dynamic mixing model was used to estimate characteristic times for a transient jet of cold reactants to mix with an ambient environment of hot products to an ignition temperature. These calculated time scales compared well with measured values in both trend and magnitude. It has also been shown that a simple sum of the characteristic mixing times and chemical kinetics times provides a good first-order approximation to the total ignition delay time.

4220 Mining and Underground Engineering

37398 (FRCEA-TH–267) **Horizontal vibrations of piles in a centrifuge.** Bourdin, B. CEA Centre d'Etudes Scientifiques et Techniques d'Aquitaine, 33 - Le Barp (France); Bordeaux-1 Univ., 33 (France). 1987. 141p. (In French). Order Number DE90502112. Available from NTIS (US Sales Only), PC A07/MF A01.

The aim of the thesis is the study of soil dynamics for important structures like nuclear power plants, offshore platforms, dams etc. Experimental results of horizontal vibrations on a pile partially anchored in a soil scale model put into a centrifuge are presented. Mechanical similitude conditions from equilibrium equations or rheologic laws are described. After a description of testing equipment (centrifuge, electrodynamic excitator) experimental results are interpreted with a model. Non-linearities on frequency response curves are characterized.

37399 (SAND–90-1063C) **Experimental and computational investigation of the fundamental mechanisms of cratering.** Thorne, B.J. (Sandia National Labs., Albuquerque, NM (USA)); Hommert, P.J.; Brown, B. Sandia National Labs., Albuquerque, NM (USA). [1990]. 25p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900821–2: 3. international symposium on rock fragmentation by blasting, Brisbane (Australia), 26-31 Aug 1990). Order Number DE90009568. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Early attempts at estimation of stress wave damage in blasting by use of finite element analysis met with limited success due to numerical instabilities that prevented calculations from being carried to late times after significant fragmentation had occurred. A new damage model based on microcrack growth in tension allows finite element calculations which remain stable at late times. Estimation of crater profiles for blasting experiments in granite, using laboratory properties for all parameters, demonstrate a high level of success for this damage model. However, estimated crater profiles show systematic differences from excavated crater profiles which motivate further developments of this model. 19 refs., 16 figs.

4250 Power Cycles

Refer also to citation(s) 36859, 36868, 36887, 37143, 37145

37400 (CONF-860676–4) **Ross-Stirling engines: Variations on a theme.** Walker, G.; Fauvel, R. Calgary Univ., AB (Canada). Dept. of Mechanical Engineering. [1986]. 19p. Sponsored by Natural Sciences and Engineering Research Council of Canada. From 3. international Stirling engine conference; Rome (Italy); 25-27 Jun 1986. Order Number DE90012562. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI.

A new mechanism called the Ross linkage offers the prospect for compact, lightweight, long-lived, relatively low-cost, Stirling engines with excellent prospects for early commercial developed for various applications. Ross-Stirling engines are unusually compact, with installation envelope about one-third of conventional engines, piston side forces are virtually eliminated facilitating the use of dry lubricated or close tolerance, gas lubricated seals and the linkage geometry automatically favors the large bore/short ratios preferred for Stirling engines. The linkage is simple to make with few moving parts so that cost is relatively low. Various potential or actual embodiments of Ross-Stirling engines are reviewed including Stirling-Stirling gas-fired heat pumps, multicylinder power systems and cryocoolers. The system has sufficient flexibility to readily accommodate widely disparate piston stroke and cylinder diameters. Most work has been done so far with two-piston Stirling engines but the same linkage may be adopted for piston-displacer Stirling engines. 6 refs., 10 figs.

37401 (CONF-860676–5) **Dynamics of the Ross-Stirling engine.** Doige, A.G.; Walker, G. Calgary Univ., AB (Canada). Dept. of

Mechanical Engineering. [1986]. 15p. Sponsored by Natural Sciences and Engineering Research Council of Canada. From 3. international Stirling engine conference; Rome (Italy); 25-27 Jun 1986. Order Number DE90012564. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI.

A computer model has been developed for the simulation of the dynamic loading in a Stirling engine having a Ross linkage as the drive mechanism. The model is based on a complete theoretical formulation of the dynamics of the system. The masses and moments of inertia of all moving components have been included in the model. The computer program can be used for determining the effect of changes in many design parameters on the geometry, velocities, accelerations, dynamic loading and reactions at all pin connections and engine-mount locations. In this paper, emphasis is given to assessing the general characteristics of the reaction forces at the pin connections and to the reduction of overall engine shaking forces by simple balancing methods. The most heavily loaded element in the engine is the pin connecting the crank and the yoke. The force at that location is a combination of a static load produced by gas pressure in the cylinders and a combined inertia load for the whole engine which increases with the square of the rotational speed. 6 refs., 12 figs., 2 tabs.

4260 Components, Electron Devices and Circuits

Refer also to citation(s) 37138, 37227, 37244, 37298, 37304, 37311, 37384, 37394, 37460, 37512, 37555, 37556, 37557, 38268, 38269

37402 (EGG–10617-5059) **Curve fitting and error modeling for the digitization process near the Nyquist rate.** Baumgart, C.W. (EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations); Moses, J.D.; Dunham, M.E. EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations. [1990]. 45p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-88NV10617. Order Number DE90012679. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Shannon/Nyquist sampling theorems were derived for time-quantized signals which did not include simultaneous amplitude quantization. In addition, underlying assumptions on which these theorems were based are violated in typical use. Therefore, actual practice in data acquisition has been two to three times oversampling of signal bandwidth to conserve accuracy. We report a numerical investigation of digitization process accuracy versus sample rate, sample amplitude resolution, and record length. This investigation is based on the use of curve fitting and Monte Carlo techniques to reconstruct original analog test signals from their ideally digitized representations. Fit sensitivity with respect to each digitization variable is derived from the Monte Carlo analysis. We find that although no specific Nyquist limit exists for a known wave shape, parameter errors vary continuously with respect to the aforementioned variables, and critical sample densities of two to four sample periods per risetime are seen. Plots of curve-fitted parameter error versus fundamental digitization variables are useful in specifying experimental tasks and indicate new directions for reconstruction algorithm development. 15 refs., 18 figs.

37403 (EP-LULI-RA–1988) **The utilization of high-intensity lasers.** Fabre, E. (Centre National de la Recherche Scientifique (CNRS), 75 - Paris (FR)). Ecole Polytechnique, 91 - Palaiseau (France). 1988. 39p. (In French). Order Number DE90500846. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the laboratory for the Utilization of High-Intensity Lasers (Polytechnic School, France), is presented. The research program is focused on the laser-plasma physics, on the generation of high pressures by means of laser shock heating, on the laser spectroscopy and on the laser implosions. Numerical simulation codes are developed. Concerning the atomic physics, the investigations on dense plasmas and the x-laser research developments are carried out. The research activities of the laboratory teams, the published papers, the national and international cooperations, are given.

37404 (FNAL-TM–1657) **Ampacity test of 28 AWG ribbon cables.** Drennan, E. Fermi National Accelerator Lab., Batavia, IL (USA). Apr 1990. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE90012019. Available from NTIS, PC A03/MF A01 - OSTI.

This report contains the results of testing ribbon cables in order to determine the amount of current they can carry. In some experiments ribbon cables are used to power circuit boards and carry several amperes of current. These tests were required to establish safe operating current limits for electrical safety reviews. The basic principle behind these tests was to increase the amount of current passed through the ribbon cables until the insulation melted and the cable clearly became a fire hazard. As the current through the cable was increased the copper temperature was determined from the increased conductor resistance. The tests were done on two different types of ribbon cables. One was the flat 26 conductor 28AWG and the other was the twist and flat 26 conductor 28AWG ribbon cable, both of which are commonly used in the experiments. The flat cable was tested for current carrying capacity through three conductors and through a single conductor. The twist and flat cable was tested for current carrying capacity through a single conductor. It was found that the maximum single conductor ampacity for both cables is approximately 3A and the three conductor ampacity for the flat cable is about 10A. 4 figs., 3 tabs.

37405 (FNAL-TM–1660) **Investigation of the mechanical properties of superconducting coils.** Markely, F.W.; Kerby, J.S. Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-900348–9: 2. international industrial symposium on the super collider, Miami, FL (USA), 14-16 Mar 1990). Order Number DE90012020. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper presents data on 3 of the important mechanical properties of SSC type superconducting coils. The measured properties are: (1) The azimuthal elastic modulus of the coil samples made for the stress relaxation tests. (2) The rate of stress — relaxation of collared SSC outer coils molded to different sizes and (3) The pressures that various insulations can withstand during molding or collaring before turn-to-turn shorts develop. Additional data on these and other properties are available but omitted here because of space limitations. 3 refs., 10 figs.

37406 (LA-UR–90-964) **Experiments on superconductor imaging surface magnetometry.** Overton, W.C. Jr.; van Hulsteyn, D.B.; Flynn, E.R. Los Alamos National Lab., NM (USA). [1990]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-900806–3: 19. international conference on low temperature physics, Brighton (UK), 16-22 Aug 1990). Order Number DE90008925. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The recent development of a new concept in magnetometry has led to experiments to evaluate the performance of such systems. The superconductor imaging surface magnetometer employs superconducting plates and shells to deflect magnetic noise and to image nearby dipole sources while the SQUID pick-up coils are located in areas where the noise has been greatly reduced. The experiments herein reported confirm the principles of imaging magnetometry for detecting nearby dipole sources. 2 refs., 2 figs., 1 tab.

37407 (SAND–89-2605C) **Simulation fidelity in reactor irradiation of electronics.** Luera, T.F. Sandia National Labs., Albuquerque, NM (USA). [1990]. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900814–4: 7. ASTM-EURATOM symposium on reactor dosimetry, Strasbourg (France), 27-31 Aug 1990). Order Number DE90013064. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Nuclear reactors are used in the neutron and gamma ray irradiation testing of electronic devices to qualify them for use in radiation environments. In general, radiation environments obtained at test or research reactors differ from the operational environments in which the electronics must perform their intended function. Additionally, all electronic parts which make up a system, and all part lots, may not be tested at the same reactor facility. In order to correctly interpret the test data and assess device performance in the operational environment it is necessary to: have a basic understanding

of the damage mechanisms relating to the operational and test environments; adequately control the test environment; and employ a validated damage equivalence methodology. The facility of the test simulation need not rely on precise duplication of the operational environment if these three considerations are properly addressed. It is tacitly assumed in the above discussion that required electrical tests are properly performed. ASTM 10.07 is examining the feasibility of creating a matrix standard to show the relationships among the various dosimetric, electrical, and other standards which should be employed to assure test validity. 8 refs.

37408 (SAND–89-3137C) **A repetitive, one microsecond, thirty-five kilojoule, two hundred kilovolt pulse generator.** Rinehart, L.F.; Clark, R.S.; Buttram, M.T.; Mikkalson, J.E.; Patterson, P.E. Sandia National Labs., Albuquerque, NM (USA). [1990]. 6p. Sponsored by U.S. Department of Defense. DOE Contract AC04-76DP00789. Contract AFWL 86-159. (CONF-9006176–6: 19. power modulator symposium, San Diego, CA (USA), Jun 1990). Order Number DE90013063. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The objective of this work has been to produce a compact, lightweight, high-energy modulator. The device was to power various low-impedance loads including up to 25 vacuum diodes in parallel. Desired characteristics were a 1-microsecond rectangular pulse of 200-kV amplitude into 1- to 2.5-ohm loads. Pulse repetition rates from single shot to 10 pulses per second (PPS) were required. A modular design was employed in which two 17.5 kJ, type "C" Pulse Forming Networks (PFNs) were stacked and their outputs added in series to meet the pulse requirements. The design and construction of each module and the interconnecting circuitry is presented. Problem areas in the pulser development included: low inductance design; spark gap switch stability, efficiency, and simultaneity; and fast (100 ms) charging of the high-energy PFN for 10-PPS operation. Each of these issues is addressed in this paper. 11 refs., 9 figs.

37409 (SAND–90-0048) **Microsensor research.** Hughes, R.C.; Drebing, C.G. (eds.). Sandia National Labs., Albuquerque, NM (USA). Apr 1990. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90011801. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The technology that led to very large-scale integrated circuits on silicon chips also provides a basis for new microsensors that are small, inexpensive, low power, rugged, and reliable. Two examples of microsensors Sandia is developing that take advantage of this technology are the microelectronic chemical-sensor array and the radiation-sensing field-effect transistor (RADFET). Increasingly, the technology of chemical sensing needs new microsensor concepts. Applications in this area include environmental monitoring, criminal investigations, and state-of-health monitoring, both for equipment and living things. Chemical microsensors can satisfy sensing needs in the industrial, consumer, aerospace, and defense sectors. The microelectronic chemical-sensor array (Figure 1) may address some of these applications. We have fabricated six separate chemical gas-sensing areas on the microelectronic chemical-sensor array. By using different catalytic metals on the gate areas of the diodes, we can selectively sense several gases. 14 refs., 12 figs.

37410 (SAND–90-0061C) **Recovery of high field GaAs photoconductive semiconductor switches.** Zutavern, F.J.; Loubriel, G.M.; O'Malley, M.W.; Schanwald, L.P.; McLaughlin, D.L. Sandia National Labs., Albuquerque, NM (USA). [1990]. 7p. Sponsored by U.S. Department of Defense. DOE Contract AC04-76DP00789. (CONF-9006176–5: 19. power modulator symposium, San Diego, CA (USA), Jun 1990). Order Number DE90013062. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

GaAs photoconductive semiconductor switches (PCSS) are useful as fast recovery switches at electric field stresses below 3.5–8 kV/cm. Following a short activating light pulse in this low field regime, the switch resistance increases roughly exponentially with time constants ranging from 0.1–1000 ns, depending on the type of GaAs. At higher fields, however, the resistive recovery depends not only on material properties, but also on the minimum resistance reached during the activating light pulse (trigger resistance), the wavelength of the light pulse, and the field remaining across the switch during recovery. In particular, if the switch is activated with a significantly intense light pulse, it will stay on and maintain the circuit-dependent impedance which is required to hold a constant, material-dependent field across the switch (lock-on). Since the circuit-dependent impedance achieved during lock-on can be several orders of magnitude less than the resistance required for triggering, a substantial savings can be made in the optical energy required to activate the switch. The lock-on switching mode shows gain relative to linear (low-field) PCSS. Fast recovery of GaAs switches after high field switching is of particular interest for high repetition rate applications where it is difficult to provide the large optical trigger energy required for switches operating at low fields. We have explored three categories of circuits to induce fast recovery after lock-on by temporarily reducing the field across the switch. Measurements of recovery times from 35–80 ns, multiple monopolar and bipolar bursts at 5–40 MHz, and hold-off fields ranging from 5–44 kV/cm (corresponding to 15–66 kV across individual switches), will be presented. A comparison will be made of the different circuits used to induce recovery from lock-on and the various factors that influence the recovery will be discussed. 12 refs., 10 figs.

37411 (SAND–90-0419C) **The repetitive high energy pulsed power module.** Harjes, H.C.; Reed, K.W.; Buttram, M.T.; Turman, B.N.; Neau, E.L.; Martinez, L.; Adcock, J.; Weinbrecht, E.A.; Mann, G.A.; Morgan, F.A. Sandia National Labs., Albuquerque, NM (USA). [1990]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9006176–7: 19. power modulator symposium, San Diego, CA (USA), Jun 1990). Order Number DE90013076. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

High average power magnetic pulse compression systems are being considered for use in several applications. One of the key issues in the design of a pulsed power driver for these applications is component reliability, efficiency, and lifetime. In the Repetitive High Energy Pulsed Power (RHEPP) module, pulse compression is done exclusively with magnetic switches (saturable reactors) because such switches have the potential of performing efficiently and reliably for $>10^{10}$ shots. The objective of the RHEPP project is to explore the feasibility of using magnetic pulse compression technology in continuous high average power applications. The RHEPP system consists of a compressor which drives a linear induction voltage adder with a diode load. Prime power for the module is supplied by a 600 kW, 120 Hz, alternator (furnished by Westinghouse Electric Corporation). At present, construction and initial testing in a bipolar mode of the first two stages of the compressor has been completed. This system has operated for a total of 332 minutes (4.8×10^6 pulses) at full power (600 kW) with an efficiency of 94+/−3%. The first stage magnetic switch (MS1) has a pulse compression factor of 8.4 (4.2 ms to 500 μs time to peak). It has two, parallel connected, 67 turn copper coils and a 760 kg core of 2 mil silicon steel with a magnetic cross sectional area of 0.065 m^2. The second stage magnetic switch (MS2) has a pulse compression factor of 3 (500 μs to 170 μs). It has two, parallel connected, 36 turn copper coils and a 361 kg core of field annealed 2605CO Metglas with a magnetic area of 0.019 m^2. A discussion of RHEPP compressor design effort and its baseline design is given. In addition, initial results from the operation of the first two stages are presented. 11 refs., 8 figs., 4 tabs.

37412 (SAND–90-0646C) **Thermal effects on the Josephson series-array voltage standard.** Duncan, R.V. Sandia National Labs., Albuquerque, NM (USA). [1990]. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900806–1: 19. international conference on low temperature physics, Brighton (UK), 16-22 Aug 1990). Order Number DE90008738. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Microfabricated series-arrays of Josephson junctions have been developed which are capable of producing quantized voltage levels over a wide voltage range. These arrays have been used in a calibration system since February 10, 1987 to maintain the US Legal Volt at the National Institute of Standards and Technology (NIST, formerly NBS). A similar system within the Primary Standards

Laboratory (which is operated for the Department of Energy, Albuquerque Operations Office by Sandia National Laboratories (SNL)) has been in operation since July, 1989. Measurements of the temperature dependence of the array's quantized voltage states and DC characteristics are reported here. 8 refs., 2 figs.

37413 Development of composite polymer-glass edge claddings for Nova Laser Disks. Campbell, J.H.; Edwards, G.; Frick, F.A.; Gemmell, D.S.; Gim, B.M.; Jancaitis, K.S.; Jessop, E.S.; Kong, M.K.; Lyon, R.E.; Murray, J.E. pp. 19-41 of Laser induced damage in optical materials 1986. Bennett, H.E.; Guenther, A.H.; Milam, D.; Newnam, B.E. US Government Printing Office, Washington, DC (USA) (1988). (CONF-861124--: 18. symposium on optical materials for high power lasers, Boulder, CO (USA), 3-5 Nov 1986).

Large Nd:glass laser disks for disk amplifiers require an edge cladding which absorbs at 1 μ m. This cladding prevents edge reflections from causing parasitic oscillations that would otherwise deplete the gain. The authors have developed a composite polymer-glass edge cladding that consists of absorbing glass strips bonded to the edges of laser glass disks using an epoxy adhesive. The edge cladding must survive a fluence of approximately 20 J/cm^2 in a 0.5-ms pulse. Failure can occur either by decomposition of the polymer or by mechanical failure from thermal stresses which leads to bond delamination. An epoxy has been developed that gives the required damage resistance, refractive index match and processing characteristics. A slight tilt of the disk edges greatly reduces the threat from parasitic oscillations and a glass surface treatment is used to promote bond adhesion. Laser disks fabricated with this new cladding show identical gain performance to disks using conventional fused-glass cladding and have been tested for over 2000 shots (equivalent to about a 4-year lifetime on Nova) with out degradation.

37414 Identification of hydrogenlike and heliumlike transitions in the spectrum of laser-produced magnesium plasmas. Moreno, J.C. (Laboratory for Plasma Research, University of Maryland, College Park, Maryland 20742-3511 (USA)); Goldsmith, S.; Griem, H.; Cohen, L.; Knauer, J. *Journal of the Optical Society of America, Part B: Optical Physics (USA),* 7(5): 704-707 (May 1990). DOE Contract AS08-86DP10554.

Nonresonance spectral lines of Mg XII and Mg XI emitted by magnesium laser-produced plasmas have been observed in the extreme-vacuum-ultraviolet region and their transitions classified. As many as eight beams of the Omega laser system of the Laboratory for Laser Energetics at the University of Rochester were linearly focused onto magnesium-coated flat targets to produce linear plasma radiation sources from 3 to 6 mm long. The spectra were photographed end-on with a grazing-incidence spectrograph. The identified Mg XII lines are classified as 2*s*–3*p*, 2*p*–3*d*, 2*s*–4*p*, 2*p*–4*d*, and 3*d*–4*f* transitions. The identified Mg OI lines are classified as 1*s*2*s*–1*s*3*p*, 1*s*2*p*–1*s*3*d*, 1*s*2*p*–1*s*4*d*, 1*s*3*p*–1*s*4*d*, and 1*s*3*d*–1*s*4*f*. Ionization differentiation is based on comparing the present data with other magnesium spectra emitted from plasmas produced by different sources or differing in the ionization conditions. Transition classification is based on comparing the experimental wavelengths with the calculated values and studying the correlation between observed line intensities and the calculated oscillator strengths.

37415 Excitation of atoms passing through a TEM$_{00}$ Gaussian laser beam at relativistic velocities. Quick, C.R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (USA)); Bryant, H.C. *Journal of the Optical Society of America, Part B: Optical Physics (USA),* 7(5): 708-714 (May 1990).

The spectral distribution seen by an atom crossing a monochromatic Gaussian TEM$_{00}$ with a relativistic speed normal to the direction of propagation of the beam is shown to be independent of the distance between the atom's path and the position of the beam's minimum waist. The dependence of the transition probability on the beam coordinates is also given. Finally, it is shown that the spectral width can be viewed as being due to the angular distribution of the plane waves of which the Gaussian TEM$_{00}$ beam is composed.

37416 Propagation of high energy laser beams through metallic aerosols. Armstrong, R.L. (New Mexico State University, Physics Department, Las Cruces, New Mexico 88003 (USA)); Zardecki, A. *Applied Optics (USA),* 29(12): 1786-1792 (20 Apr 1990).

We investigate the propagation of high energy laser beams through vaporizing metallic aerosols in the regime for which plasma generation becomes important. Plasma forms in the vapor layer surrounding the irradiated aerosols particles. Both plasma initiation and dynamics are studied. To describe plasma absorption, we include the effects of inverse bremsstrahlung and photoionization. An effective plasma absorption coefficient allows us to set up a coupled system of equations describing the system consisting of the beam and aerosol vapor.

37417 Optimization and characterization of a high repetition rate, high intensity Nd:YLF regenerative amplifier. Saeed, M. (Brookhaven National Laboratory, Chemistry Department, Upton, New York 11973 (USA)); Kim, D.; DiMauro, L.F. *Applied Optics (USA),* 29(12): 1752-1757 (20 Apr 1990). DOE Contract AC02-76CH00016.

Solid state regenerative amplifiers have proved to be a reliable source for producing stable millijoule pulses as short as a few picoseconds at repetition rates ranging from a few hertz to several kilohertz. Here we report on the operation of a cw pumped Nd:YLF regenerative amplifier that uses a convex–concave density on critical intracavity optical components. The amplifier yields stable 5-mJ 40-ps pulses at 700 Hz and has achieved 1-mJ output at a 3.5-kHz repetition rate. Results and analysis of the beam profile and contrast ratio for this system are also presented. Our results are contrasted to the general design considerations of regenerative amplifiers.

37418 Low threshold current implanted-planar buried-heterostructure graded-index separate confinement heterostructure laser in GaAs/AlGaAs. Vawter, G.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185 (USA)); Myers, D.R.; Brennan, T.M.; Hammons, B.E. *Applied Physics Letters (USA),* 56(20): 1945-1947 (14 May 1990). DOE Contract AC04-76DP00789.

We report dramatic improvements to the implanted-planar buried-heterostructure graded-index separate confinement heterostructure (IPBH-GRINSCH) laser in (AlGa)As/GaAs which produces low threshold current, continuous-wave operation. Our process features significantly reduced fabrication complexity of high quality, index-guided laser diodes compared to regrowth techniques and, in contrast to diffusion-induced disordering, allows creation of self-aligned, buried, blocking junctions by ion implantation. The improved single-stripe IPBH-GRINSCH lasers exhibit 39 mA threshold current, cw operation.

37419 Generating radially polarized beams interferometrically. Tidwell, S.C. (Spectra Technology, Inc., 2755 Northup Way, Bellevue, Washington 98004-1495 (US)); Ford, D.H.; Kimura, W.D. *Applied Optics (USA),* 29(15): 2234-2239 (20 May 1990). DOE Contract AC06-83ER40128.

Two interferometric techniques for converting a linearly polarized laser beam into a radially polarized beam with uniform azimuthal intensity are described. The techniques are based on the linear combination of orthogonally polarized beams, which have tailored intensity and phase profiles. Linearly polarized beams with intensity profiles tailored using a modified laser or an apodization filter are combined in separate experiments to produce radially polarized light. A beam with an extinction ratio of −21.7 dB and azimuthal intensity variations of less than ±12% is produced using the modified laser output. The second technique uses circularly polarized light and a unique spiral phase delay plate to produce the required phase profile. When focused, a radially polarized beam has a net longitudinal field useful for particle acceleration and, perhaps, other unique applications.

37420 Superconducting thin-film multiturn coils of $YBa_2Cu_3O_{7-x}$. Wellstood, F.C. (Department of Physics, University of California, Berkeley— Center for Advanced Materials— Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory,

Berkeley, California 94720 (USA)); Kingston, J.J.; Clarke, J. *Applied Physics Letters (USA)*, 56(23): 2336-2338 (4 Jun 1990). DOE Contract AC03-76SF00098.

We describe a technique for fabricating superconducting thin-film multiturn coils from the high-temperature superconductor $YBa_2Cu_3O_{7-x}$. We have built 10-turn and 19-turn square spiral coils, 1 mm on a side, that are suitable for coupling to a thin-film dc superconducting quantum interference device. The coils are constructed with a three-layer crossover technology using $SrTiO_3$ as an insulator. Each layer is deposited *in situ* with a pulsed excimer laser, and is patterned with shadow masks or photoresist and an Ar ion mill. The best coil had a transition temperature of approximately 82 K, and a critical current at 77 K of 1.4 mA, corresponding to a critical current density of 2×10^4 A cm^{-2}.

37421 Schottky barrier contacts on defect-free GaAs (110). Liliental-Weber, Z. (Lawrence Berkeley Laboratory 62-203, 1 Cyclotron Road, Berkeley, California 94720 (USA)); Weber, E.R.; Washburn, J.; Weaver, J.H. *Applied Physics Letters (USA)*, 56(25): 2507-2509 (18 Jun 1990). DOE Contract AC03-76SF00098.

High resolution transmission electron microscopy and analytical electron microscopy show direct evidence for defect-free interfaces produced by *in situ* cluster deposition of Au, Ag, and Ti onto ultrahigh vacuum-cleaved *n*-GaAs. In contrast to interfaces produced by atom-by-atom deposition, no specific interface reconstruction or orientation relationship and no change of stoichiometry of the GaAs near the interface was observed. Schottky barrier heights correspond to unusual Fermi level pinning positions in the upper half of the GaAs band gap, in clear contrast to values obtained for atom deposition and for diodes prepared by standard technology on GaAs (100). These results give clear evidence that Fermi level pinning for metal/GaAs interfaces formed without defects does not follow the predictions of current metal-induced gap-state models.

37422 Ion-channel laser. Whittum, D.H. (Lawrence Berkeley Laboratory, Berkeley, California 94720 (USA)); Sessler, A.M.; Dawson, J.M. *Physical Review Letters (USA)*, 64(21): 2511-2514 (21 May 1990). DOE Contract AC03-76SF00098 ;FG03-87ER13752.

A relativistic electron beam propagating through a plasma in the ion-focused regime exhibits an electromagnetic instability with peak growth rate near a resonant frequency $\omega\sim2\gamma^2\omega_\beta$. Growth is enhanced by optical guiding in the ion channel, which acts as a dielectric waveguide, with fiber parameter $V\sim1(I/I_A)^{1/2}$. A 1D theory for a laser making use of this instability is formulated, scaling laws are derived, and numerical examples are given. Possible experimental evidence is noted.

37423 Spin-polarized scanning tunneling microscope: Concept, design, and preliminary results from a prototype operated in air. Johnson, M. (Department of Physics, University of California, Berkeley, CA (USA)); Clarke, J. *Journal of Applied Physics (USA)*, 67(10): 6141-6152 (15 May 1990). DOE Contract AC03-76SF00098.

We describe the concept of the spin-polarized scanning tunneling microscope. It consists of a ferromagnetic tip with saturated magnetization from which spin-polarized electrons tunnel into a ferromagnetic sample which has its axis of magnetization aligned with that of the tip. When the magnetization of the sample is alternated periodically from parallel to antiparallel, a portion of the tunnel current is predicted to oscillate at the same frequency, with an amplitude linearly proportional to the average tunnel current. The construction of a prototype microscope, operated in air, is described. When the sample magnetization is alternated, a modulation of the tunnel current is observed at the same frequency. This signal satisfies criteria developed to characterize spin-polarized tunneling. Spurious signals are also observed and their probable origins identified. A number of improvements are suggested that should eliminate the spurious effects.

37424 Effect of temperature on data retention of silicon-oxide-nitride-oxide-semiconductor nonvolatile memory transistors. Miller, S.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185 (USA)); McWhorter, P.J.; Dellin, T.A.; Zimmerman, G.T. *Journal of Applied Physics (USA)*, 67(11): 7115-7124 (1 Jun 1990).

The discharge behavior of silicon-oxide-nitride-oxide-semiconductor nonvolatile memory transistors is investigated for a range of programming and storage temperatures spanning −55 °C to 200 °C. A number of empirical observations strongly limit the nature of the mechanisms that govern charge injection and decay. Both electrons and holes contribute to the charge storage properties of the transistors, and the decay properties of both are thermally activated with a continuous distribution of activation energies (trap depths). Charge decay, for both charge states, is negligibly limited by mechanisms other than those which are strongly thermally activated. The programming temperature, relative to the storage temperature, significantly impacts the retention time of the excess electron state, while not affecting the long term decay of the excess hole state. The experimental results also have significant implications regarding proper retention screening techniques and nonvolatile ROM programming techniques.

37425 Laser-diode-pumped, erbium-doped, solid-state laser with high slope efficiency. Esterowitz, L.; Allen, R.; Kintz, G. To Department of the Navy, Washington, DC (US). USA Patent Application 7-429,426. 31 Oct 1989. 15p. Available from NTISPC N03/MF A01.

This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of application available NTIS.

A laser and method for producing a laser emission at a wavelength of substantially 2.8 microns is disclosed. In a preferred embodiment of the invention, the laser comprises laser diode means for emitting a pump beam at a preselected wavelength; and a crystal having a preselected host material doped with a predetermined percent concentration of erbium activator ions sufficient to produce a laser emission at substantially 2.8 microns at a slope efficiency of at least 5 percent, but preferrably 10 percent, when the crystal is pumped by the pump beam. It is well known that the human body is comprised of approximately 70% water, with various human tissues containing about 60% to 90% of water, and bone and cartilage containing about 30% to 40% of water. Since the 2.8 micron wavelength has a substantially maximum absorption in water, this 2.8 micron wavelength is the ideal wavelength to use for a large variety of medical laser applications on the human body. A 2.8 micron wavelength laser could be used for precise surgery in such exemplary applications as brain surgery, neurosurgery, eye surgery, plastic surgery, burn treatment and the removal of malignancies.

43 PARTICLE ACCELERATORS

Refer also to citation(s) 37328, 37329, 37837, 38305

37426 (CEA-CONF–9834) **Electron accelerators and nuclear physics.** Frois, B. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie. 1989. 7p. (CONF-890388–: 4. European Physical Society (EPS) seminar on international research facilities, Zagreb (Yugoslavia), 17-19 Mar 1989). Order Number DE90500820. Available from NTIS (US Sales Only), PC A02/MF A01.

The operating electron accelerators and their importance in the nuclear and in the particle physics developments, are underlined. The principles of probing the nucleus by applying electron scattering techniques and the main experimental results, are summarized. In order to understand hadron interactions and the dynamics of quark confinement in nuclei, the high energy electrons must provide quantitative data on the following topics: the structure of the nucleon, the role of non nucleonic components in nuclei, the nature of short-range nucleon correlations, the origin of the short-range part of nuclear forces and the effects of the nuclear medium on quark distributions. To progress in the nuclear structure knowledge it is necessary to build a coherent strategy of accelerator developments in Europe.

37427 (LAL-RT–88-09) **LAL contributions to the 1st EPAC conference.** Boussoukaya, M.; Dubrovin, A.; Bienvenu, G.; Girault, P.; Bourdon, J.C. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Jul 1988. 25p. (CONF-880695–: 1. European Particle Accelerator Conference (EPAC-1), Rome (Italy), 7-11

Jun 1988). Order Number DE90500813. Available from NTIS (US Sales Only), PC A03/MF A01.

The Linear Accelerator Laboratory contributions to the first European Particle Accelerator Conference, are presented. A new method on the field of high brightness laser driven electron sources, is described. The experimental results, involving high emissivity photocathodes in moderate (30 KV) and high (more than 100 KV) voltage configurations, are given. The simulation code, capable to work on rf devices, is explained; it is able to take advantage of time stepping and to get closer to the real case of the Orsay (France) lasertron. The behaviour of warm accelerating rf structures under high gradient is investigated. The design of the structure, the evaluations of the peak field and the energy gain of a 4 pi/S H-coupled backward TW system, are presented; the device is applied to improve the electron linacs optimixation. The status, the general description, and the main components of the project concerning a 50/80 MeV linac, devoted to an infrared free electron laser, is summarized.

37428 (NAC-AR-88-01) **Annual report June 1988.** National Accelerator Centre, Faure (South Africa). 1988. 286p. Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

This annual report reviews the activities of the National Accelerator Centre until June 1988. The 200 MeV cyclotron facility, the Pretoria cyclotron facility and the Van De Graaff facility are discussed in detail. Aspects of the 200 MeV cyclotron facility examined are, inter alia: the injector cyclotrons, the separated-sector cyclotron, the control system, the beam transport system and radioisotope production. Separate abstracts were prepared for the various subdivisions contained in this annual report.

37429 (NAC-AR-89-01) **Annual report June 1989.** National Accelerator Centre, Faure (South Africa). 1989. 261p. Available from the National Accelerator Centre, PO Box 72, Faure, 7131, South Africa.

Major milestones were recorded by each of the National Accelerator Centre's accelerators during the 1988/89 year. Firstly, as planned more than a year earlier, the Pretoria cyclotron was finally closed down on the 18th of November 1988. After the cyclotron was shut down the personal preferences of the Pretoria staff members were accommodated as far as possible, and about half of them moved down to Faure. All usable equipment was also transferred to the NAC site. The routine production and supply of medical radioisotopes to the large South African hospitals was taken over by the new centre at Faure with minimum interruption. Secondly, the Van de Graaff accelerator notched up twenty-five years of operation and continued to run reliably while serving a broad spectrum of users in the fields of solid state, atomic and nuclear physics and the applications of nuclear analytical techniques. Thirdly, the new cyclotron facility completed its second year of routine operation at the end of January 1989 with an excellent record of beam availability. Routine treatment of cancer patients with neutrons started in February 1989 and a total of 39 patients were treated up to the end of June 1989. With most of the teething problems resolved, operation of the separated-sector cyclotron has settled down into a fixed routine. A number of additions and modifications to the accelerators and associated equipment to improve reliability and ease of operation were effected during the year. Good progress was made with the design, manufacture and installation of a number of uncompleted facilities like the second injector cyclotron with its ion sources for heavy ions and polarized light ions, the magnetic spectrometer, the beam swinger for neutron time-of-flight experiments and additional hot cells for radioisotope production. Planning of facilities for proton therapy has continued.

4301 Design, Development, and Operation

Refer also to citation(s) 37405, 37453, 37555, 37556, 37644, 37836, 38288, 38297

37430 (BNL-44618) **Proceedings of the CAP [Center for Accelerator Physics] meetings, October 1989-April 1990.** Brookhaven National Lab., Upton, NY (USA). 2 Apr 1990. 174p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE90012412. Available from NTIS, PC A08/MF A01; OSTI; INIS.

This report discusses: an immersed field cluster klystron; emittance and moments in accelerators, and beamlines; emittance analysis for ATF transport beamline; photocathodes; ATF- photocathode rf gun; re-evaluation of ATF — photocathode rf gun and the transport beamline with parmela; ATF Nd: YAG laser; recent results for SSC superconducting magnets; the status of BNL muon storage ring and G — 2 experiment.

37431 (DOE/ER/40150-126, pp. 54-57) **A flight-qualified RFQ for the BEAR project.** Schrage, D.; Young, L.; Campbell, B.; Billen, J.H.; Wangler, T.; Stovall, J.; Martinez, F.; Clark, W.; Gibbs, S.; Bolme, G. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049-: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF-89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

A 1-MeV, 30-mA, low-duty factor, 425-MHz RFQ has been designed and constructed for the BEAR (Beam Experiments Aboard a Rocket) Project by Los Alamos National Laboratory, Grumman Space Systems Division, and GAR Electroformers. The design of this 1-m-long, lightweight (<55-kg) accelerator is unique in that it was constructed of four copper-plated aluminum quadrants joined longitudinally by a room-temperature electroforming process to produce a monolithic structure. There are no rf, vacuum, or mechanical joints in the vane/cavity region of the accelerator. As part of the design/fabrication process, spark-test, cold, and engineering model RFQs were constructed and tested. The completed flight unit has successfully passed static structural and thermal tests as well as dynamic structural (shake) tests according to the launch, separation, and flight specifications. In addition, the rf field distributions and beam-transport characteristics have been measured and found to satisfy the design requirements. 12 refs., 2 figs., 3 tabs.

37432 (DOE/ER/40150-126, pp. 149-154) **High energy (1-2 MeV) beams for magnetic fusion - tokamak plasma heating and current drive.** Becraft, W.R.; Whealton, J.H.; Akerman, M.A.; Barber, G.C.; Dagenhart, W.K.; Haselton, H.H.; Raridon, R.J.; Rothe, K.E.; Ryan, P.M.; Murphy, B.D. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049-: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF-89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

The next-generation fusion devices based on the tokamak confinement concept are expected to emphasize steady-state operation. Such future reactors may include designs like the International Thermonuclear Experimental Reactor (ITER) and that of the recent International Tokamak Reactor (INTOR) program. Effective means of non-inductive plasma current drive would therefore be necessary. This paper describes a concept for a current drive system based on negative ions with beam energy > 1 MeV. Preliminary physics calculations show that the core current necessary for stability enhancement can best be achieved in these future reactor-like machines with beams having energies ranging from 1 to 4 MeV. Further study and experiments will better define the optimum energy. In particular, within the last year, the plasma theorists have shown that the required energy for optimum neutral beam current drive (NBCD) efficiency is, for a machine with the parameters of ITER, approximately 1.5 MeV (US ITER Team selected 1.6 MeV). Additional calculations by Houlberg, et al, have also shown that a vertical column of parallel beams injected tangentially into the tokamaks and inside the magnetic axis can provide a beneficial contribution to the plasma current profile control. Studies of how to accomplish beams of this energy led to the system described in this paper. 11 refs., 15 figs.

37433 (DOE/ER/40150-126, pp. 221-224) **Superconducting RF for direct acceleration in TeV colliders.** Sundelin, R.M. (CEBAF, Newport News, VA (USA)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron

Beam Accelerator Facility. Jun 1989. DOE Contract AC05-84ER40150. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

The extensive effort by many of the world's best accelerator personnel which has been required for the commissioning of the SLC shows that pushing the SLC design parameters further will be extraordinarily difficult, if not impossible. Use of parameters which are equal to or less restrictive than those of the SLC, together with large-scale application of superconducting cavity gradients which have been achieved on a small scale, makes a 2 TeV e^+e^- collider worthy of consideration. The low peak power required to fill a high Q cavity and a high ratio of higher order mode damping rate to fundamental power dissipation make a linac using superconducting RF accelerating cavities and periodic bunch trains a potentially viable solution. 4 refs.

37434 (DOE/ER/40150–126, pp. 285-289) **Advanced accelerator R & D at LAL/ORSAY.** Le Duff, J. (Centre d'Orsay (France)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

An R and D program was launched at LAL, ORSAY at the end of 1985 as a contribution to the future of e^+e^- linear colliders. This program includes beam dynamics simulation, generation of short pulse high peak currents, Lasertron type RF power source, and high gradient warm structures. To fit with the experimental program, two test facilities have been built and are now operating: a 3 GHz high gradient test facility with beam, and a photocathode test facility. A description of the facilities will be given, as well as the first experimental results. 13 refs., 10 figs.

37435 (DOE/ER/40150–126, pp. 595-597) **Electron beam monochromatization in the linac used as an injector to the stretcher.** Gladkikh, P.I. (Kharkov Institute of Physics and Technology (USSR)); Dovbnya, A.N.; Tur, Yu.D.; Shendrik, V.A.; Shcherbakov, A.A. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

The Kharkov electron linac is currently under reconstruction to be used as an injector for the stretcher ring. The expected energy decrease due to the beam load is 600 MeV at a pulsed current of 200 mA. Therefore, for the beam monochromatization a combined system is being developed which includes a time-delay means, a compensating section and an RF compressor at the exit of the linac. This system will permit the energy spread caused by the beam loading during the pulse and the accelerating field variations, to be reduced from 600 MeV to 3 MeV. This report presents the calculations of the system. 2 refs., 4 figs.

37436 (DOE/ER/40150–126, pp. 675-679) **B-factories: A perspective of β-physics and possible accelerator design approaches.** Siemann, R.H. (Cornell Univ., Ithaca, NY (USA)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

Experiments studying B-meson decays have produced results that were unexpected five years ago: the B lifetime is long, and mixing or neutral B's has been observed. In addition, there is some evidence of the decay of the b-quark to the u-quark, but this result is in doubt. These measurements determine parameters of the Kobayashi-Maskawa (KM) matrix, the weak decay matrix in the Standard Model, and using those parameters, estimates can be made or CP violation asymmetries in B-meson decay. Based on these estimates, there is a prospect of observing CP violation in B-meson decay. B-mesons are produced prolifically in high energy hadron-hadron collisions; the rate at the SSC will be astronomical. However, at such machines identifying events with B's is a substantial experimental problem. In this case the challenge is one for the experimenters. The production rate is lower at $e^+ e^-$ colliders, but the experimental problems are easier. Here the challenge is to the accelerator physicists to design a high luminosity collider suitable for study of CP violation. 33 refs., 3 figs., 5 tabs.

37437 (DOE/ER/40150–126, pp. 691-695) **KEK plans for a linear collider R & D.** Horikoshi, G. (KEK, National Lab. for High Energy Physics, Ibaraki-ken (Japan)); Kimura, Y.; Nishikawa, T. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

An overall R&D activities of Japanese Linear Collider (JLC) is surveyed. The JLC is a conceptual plan of post TRISTAN projects in KEK. This is a large linear collider consisting of a pair of linear accelerators of 0.5 TeV each (for electron and positron), and a pair of damping rings. As a preliminary work, an R&D group is promoting the Test Accelerator Facility (TAF) as a pilot plan. The TAF consists of a linear accelerator with an energy of 1.5 GeV and a damping ring, and will be used for the beam acceleration test with a high gradient of 100 MV/m. An R&D on the high Tc superconducting thin film is also underway to investigate possible application to the RF accelerating structure for the superconducting linear collider. 11 refs., 7 figs., 1 tab.

37438 (DOE/ER/40150–126, pp. 696-699) **The study of a CERN linear collider, CLIC.** Schnell, W. (CERN, Geneva (Switzerland)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

At CERN work on linear colliders for electrons and positrons in the TeV energy range began with an advisory panel set up by a Long-Range Planning Committee which had been initiated by the CERN Council and was chaired by C. Rubbia. The panel (under the chairmanship of K. Johnsen) adopted the name of CERN Linear Collider (CLIC) for the subject of its work, made the tentative choice of 2 TeV for the centre-of-mass energy and initiated a study at CERN, in collaboration with other laboratories. The panel issued its final report in May 1987 and its conclusions are now being followed by the ongoing study. Although the pace of our work is limited by available funds and manpower an attempt is being made to cover all fundamental aspects of a TeV linear collider - from beam formation to the final focus system - so as to arrive at a realistic assessment of the possibility of initiating a project within the next decade. For the main linear accelerators radio-frequency structures are envisioned whose frequency is chosen as high as is permitted by beam-induced wake fields and by manufacturing problems. A tentative value of 30 GHz has been adopted. Accordingly, theoretical and computational studies of wake stabilization and development work on centimetre-wave accelerating structures form central parts of the work. Another distinctive feature of the work is the proposal of RF power generation by a two-beam scheme in which the drive beam is in the GeV energy range and receives its energy from a drive linac formed by superconducting cavities. A serious problem here is the generation and preacceleration of a tightly bunched drive beam of sufficient intensity. Consequently, preparations for a test facility for drivebeam generation form another important part of our study. 23 refs., 3 figs., 1 tab.

37439 (DOE/ER/40150–126, pp. 605-607) **Design constraints for e^+-e^- supercolliders at energies of 0.5-2.0 TeV per linac.** Chernin, D. (Science Applications International Corp., McLean, VA (USA)); Mondelli, A. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. DOE Contract AC05-85ER40216. (CONF-881049–: 14. linear accelerator conference

(LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

There is a large gap in parameters between the design point for the SLC, and the next generation of linear supercolliders, whose center-of-mass (CM) energy per elementary constituent (≈ 1-4 TeV) will rival that of the SSC. This paper explores the constraints on the linear supercollider, based on scaling SLC technology, for 0.5, 1.0, and 2.0 TeV linacs. 3 refs., 6 figs., 1 tab.

37440 (DOE/ER/40150–126, pp. 700-705) **SLAC R & D toward a TeV linear collider.** Wilson, P.B. (Stanford Univ., CA (USA)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. DOE Contract AC03-76SF00515. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

At CERN, KEK, Novosibirsk and SLAC, serious thought is being given to the design of linear colliders in the 0.5-2.0 TeV center-of-mass energy range. This paper reviews current progress at SLAC toward the design of such a collider. No attempt is made here to summarize ongoing work at the other laboratories. However, research on linear colliders is clearly an international effort, and success at SLAC will be greatly expedited by communication and cooperation with other laboratories in the U.S. and abroad. In addition to major programs at the laboratories mentioned above, contributions relevant to linear collider design are being made at DESY, LAL (Orsay), LBL, LLNL and elsewhere. 49 refs., 6 tabs.

37441 (NAC-AR–88-01, pp. 55-61) **Mechanical engineering.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

The Mechanical Engineering Division provides the other NAC divisions with design and construction services. Items of special mechanical significance are discussed here. The projects which received major design attention during the past year were: a coupling capacitor for SPC2; a bending magnet and solenoid for ECR ion source; a scanner for outer orbits of the SSC; a scattering chamber for an experimental beamline; a beam swinger; a rotary target magazine for isotope production; a robot arm for isotope production; an isotope transport system and a target cooling system for isotope production. The major projects that were under construction are: a magnetic spectrometer; a second injector cyclotron (SPC2) and extensions to the high-energy beamlines. 4 figs.

37442 (PB–90-202748/XAB) **Risks and benefits of building the superconducting super collider. Special study.** Congressional Budget Office, Washington, DC (USA). Oct 1988. 122p. Available from NTIS, PC A06/MF A01.

Also available from Supt. of Docs.

Contents: introduction–what is the Superconducting Super Collider, current status of the SSC, evaluating the SSC; the SSC and the public interest–basic science and the public interest, the federal science portfolio, economies of scale in basic science, spinoffs from the SSC; budgetary risks in the SSC project–current DOE cost estimates for the SSC, overview of budgetary risks, detectors, superconducting magnets, conventional facilities, schedule, increases in construction costs of previous accelerators, sharing the cost of the SSC; congressional options–defer the decision, build the Superconducting Super Collider, join CERN in building the large hadron collider, build an electron-positron linear collider, build the SSC using high-temperature superconductors; appendixes–technology spinoffs from government programs, technology spinoffs from CERN accelerator research, cost increases in DOE accelerators.

37443 (RAL–90-003) **Particle physics experiments 1989.** Bairstow, R. (comp.). Rutherford Appleton Lab., Chilton (UK). 1990. 153p. Order Number DE90631374. Available from NTIS (US Sales Only), PC A08/MF A01; OSTI; INIS.

This report describes work carried out in 1989 on experiments approved by the Particle Physics Experiments Selection Panel of Rutherford Appleton Laboratory. The contents consist of unedited contributions from each experiment. (author).

37444 (RAL–90-011) **Oscillator and system development on the VULCAN glass laser system for the plasma beat-wave program.** Danson, C.N. Rutherford Appleton Lab., Chilton (UK). Mar 1990. 92p. Order Number DE90631375. Available from NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

This thesis describes the oscillator and system development on the VULCAN glass laser undertaken in support of the RAL Plasma Beat-wave experiments. This program seeks to evaluate advanced particle acceleration schemes for a new generation of machines for fundamental research in high energy physics. The experiments required two synchronised high power laser pulses of slightly different wavelength. These pulses were generated using two different laser media; Nd:YAG and Nd:YLF operating at 1.064 and 1.053 microns respectively. The first oscillator system developed operated with both lasing media housed in the same laser cavity. Problems with the stability of the optical output required the development of a second system which housed the two lasing media in separate cavities. The second aspect of the development work, described in this thesis, was the reconfiguration of the VULCAN glass laser system to amplify the two laser pulses to power levels of 0.5 TW per pulse. The first scheduled experiment required the two pulses to be propagated co-linearly. To amplify the pulses to the high output powers required two amplifying media to be used which preferentially amplify the two lasing wavelengths. For the later experiments the two laser pulses were amplified in separate amplifier chains which required the design of an efficient beam combiner. (author).

37445 (SAND–89-2723C) **Temporal characterization of the 19-MV, 700-kA HERMES III electron beam.** Sanford, T.W.L.; Halbleib, J.A.; Johnson, D.L.; Poukey, J.W.; Ramirez, J.J.; Stygar, W.A.; McAtee, W.H.; Mock, R.C.; Peyton, B.; Mastin, G.A. Sandia National Labs., Albuquerque, NM (USA). [1990]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9007111–5: 8. international conference on high-power particle beams, Novosibirsk (USSR), 2-5 Jul 1990). Order Number DE90013495. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The shot-to-shot variation of the HERMES III Accelerator parameters at the electron-beam diode, the time dependence of the electron flow in the diode, and the time dependence of the subsequent radiation produced from the bremsstrahlung target are measured and compared with model results. The measurements are made with current shunts, H– range filters, a calorimeter, a fast-framing γ-ray camera, and Compton diodes. The measurements show that the peak voltage and energy delivered to the target are 19 $\pm$0.2 ($\pm$2) MV and 327$\pm$6 ($\pm$60) kJ, respectively; the electron beam converges to a radius of 14.0$\pm$0.3 cm near peak power; and the FWHM of the radiation pulse varies from 14.5$\pm$0.9 ns at the radiation focus to 23.6$\pm$0.9 ns in the far field. (The errors not in parentheses correspond to the RMS shot-to-shot variation. Those in parentheses correspond to the estimated systematic uncertainty.) The measurements agree with the calculated shot-variability and the dynamics of the electron flow, and suggest that the model can be used to predict the response from similar multistage, coaxial, high-power accelerators. With over 1000 shots accumulated between the commissioning of HERMES III and the present set of measurements, no degradation of output has been observed. 5 refs., 7 figs., 1 tab.

37446 (SAND–90-0333C) **The compact linear accelerator program at Sandia National Laboratories.** Wilson, J.M. (Sandia National Labs., Albuquerque, NM (USA)); Torrison, L.L.; Poukey, J.W.; Adler, R.J.; Humphries, S. Jr. Sandia National Labs., Albuquerque, NM (USA). [1990]. 5p. Sponsored by U.S. Department of Defense. DOE Contract AC04-76DP00789. (CONF-9006176–4: 19. power modulator symposium, San Diego, CA (USA), Jun 1990). Order Number DE90013061. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Sandia National Laboratories is currently investigating methods of producing long (several microseconds), high voltage (tens of megavolts), kiloampere electron beam pulse trains using compact linear accelerators. These machines will consist of many ferrite- or air-core cavities sized for operation at 200-250 kV with pulsewidths of 5-25 nanoseconds. A bipolar voltage waveform of 20-100 MHz frequency is required for each accelerator cavity. The electron

beam is generated and accelerated during the negative half-cycle of the input waveform, while the positive half-cycle between accelerating pulses is used to reset the ferrite cores. The electron beam generated and accelerated using such a device, therefore, is actually a long train of very short beams. At present, each cavity of our prototype accelerator (PTO) is driven by a ringing transmission line system of 5-10 ohm impedance. The core impedance and the beam impedance combine to reduce the driving voltage by approximately ten percent each half-cycle. In an effort to produce more, higher-fidelity drive pulses for a compact linear accelerator, we are now pursuing several modulator options that require fast, high-voltage, kiloampere toggling switches. The switches or switching schemes under study include photoconductive semiconductor switches, the PULSATRON switch produced by Quantum Diagnostics of Hauppauge, NY, a gated vacuum triode, and a swept electron beam oscillator. This paper will describe the original PTO design and results, the modulator experiments and results, and the next-generation cavity design.

37447 (UCRL–99636) **A compact x-ray free electron laser.** Barletta, W.A. (California Univ., Los Angeles, CA (USA). Center for Advanced Accelerators Physics); Atac, M.; Cline, D.B.; Kolonko, J.; Bhowmik, A.; Bobbs, B.; Cover, R.A.; Dixon, F.P.; Rakowsky, G.; Gallardo, J. Lawrence Livermore National Lab., CA (USA). [1988]. 9p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-8809281–2: 4. topical meeting on short wavelength coherent radiation: generation and applications, North Falmouth, MA (USA), 26-29 Sep 1988). Order Number DE90012895. Available from NTIS, PC A02/MF A01 - OSTI.

We present a design concept and simulation of the performance of a compact x-ray, free electron laser driven by ultra-high gradient rf-linacs. The accelerator design is based on recent advances in high gradient technology by a LLNL/SLAC/LBL collaboration and on the development of bright, high current electron sources by BNL and LANL. The GeV electron beams generated with such accelerators can be converted to soft x-rays in the range from 2–10 nm by passage through short period, high field strength wigglers as are being designed at Rocketdyne Linear light sources of this type can produce trains of picosecond (or shorter) pulses of extremely high spectral brilliance suitablee for flash holography of biological specimens in vivo and for studies of fast chemical reactions. 12 refs., 8 figs., 4 tabs.

37448 Reverse bending magnets in a combined-function lattice for the CLIC (CERN Liner Collider) damping ring. Delahaye, J.P. (Geneva (Switzerland)); Potier, J.P. pp. 1611-1613 of Proceedings of the 1989 IEEE (Institute of Electrical and Electronics Engineers) particle accelerator conference. Volume 3. Bennett, F.; Kopta, J. (eds.). Institute of Electrical and Electronics Engineers, New York, NY (US) (1989). (CONF-890335–Vol.3: 1989 IEEE particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989).

Damping rings with very short damping times and small normalized emittances at equilibrium are required to deliver bunches at a high rate (kHz) to high-luminosity linear colliders. In conventional rings, strong damping can only be provided by raising the energy at the expense of an increase of the equilibrium emittances or by a large number of wigglers at the expense of the dynamic acceptance. After derivation of a cell optimized for small equilibrium emittance, a compact lattice based on combined function magnets and reverse bends providing additional damping has been developed. Parameters of a small circumference ring working at a reasonable energy and fulfilling the CLIC requirements are presented with particular emphasis on dynamic acceptance. 7 refs., 6 figs., 1 tab.

37449 Test accelerator for linear collider. Takeda, S.; Akai, K.; Akemoto, M.; Araki, S.; Hayano, H.; Hugo, T.; Ishihara, N.; Kawamoto, T.; Kimura, Y.; Kobayashi, H. pp. 1841-1843 of Proceedings of the 1989 IEEE (Institute of Electrical and Electronics Engineers) particle accelerator conference. Volume 3. Bennett, F.; Kopta, J. (eds.). Institute of Electrical and Electronics Engineers, New York, NY (US) (1989). (CONF-890335–Vol.3: 1989 IEEE particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989).

KEK has proposed to build Test Accelerator Facility (TAF) capable of producing a 2.5 GeV electron beam for the purpose of stimulating R&D for linear collider in TeV region. The TAF consists of a 1.5 GeV S-band linear accelerator, 1.5 GeV damping ring and 1.0 GeV X-band linear accelerator. The TAF project will be carried forward in three phases. Through Phase-I and Phase-II, the S-band and X-band linacs will be constructed, and in Phase-III, the damping ring will be completed. The construction of TAF Phase-I has started, and the 0.2 GeV S-band injector linac has been almost completed. The Phase-I linac is composed of a 240 keV electron gun, subharmonic bunchers, prebunchers and traveling buncher followed by high-gradient accelerating structures. The SLAC 5045 klystrons are driven at 450 kV in order to obtain the rf-power of 100 MW in a 1 μs pulse duration. The rf-power from a pair of klystrons are combined into an accelerating structure. The accelerating gradient up to 100 MeV/m will be obtained in a 0.6 m long structure. 5 refs., 3 figs., 2 tabs.

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 37430, 38067, 38069, 38081, 38082, 38281, 38283, 38286, 38297, 38303

37450 (DOE/ER/40150–126, pp. 261-266) **Impedance and wakefields beyond cutoff.** Bisognano, J.J. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

The short bunch lengths and the associated high frequencies found in the latest designs of linear colliders, superconducting linacs, FEL drivers, damping rings, and synchrotron light sources have heightened the importance of understanding the high-frequency behavior of the interaction of an accelerator beam with its environment. This parametric domain is at the limits of both the numerical and analytical tools which have been developed to date, and is beyond the operational base established by existing machines. The resulting uncertainty in the coupling of a particle beam to vacuum chamber discontinuities has hindered evaluation of bunch lengthening in storage rings and transverse beam blowup in linacs, and limits confidence in assessments of beam quality in proposed designs. Recent efforts by a number of researchers have addressed the asymptotic frequency behavior of the longitudinal and transverse coupling impedance generated by discontinuities. Of particular interest is the transition from a slow rolloff, characteristic of isolated structures, to a more rapid rolloff, characteristic of an infinitely repeating structure. Another high-frequency phenomenon, which is of particular concern in damping and storage rings, is the synchrotron radiation process in the presence of conductive boundaries. Earlier estimates have indicated that this effect can provide the dominant limit on peak beam current in small, smooth-walled machines. In this paper an overview is presented of the current understanding of impedances and wakefields well above the beam pipe cutoff. Implications of these results to beam dynamics issues are discussed, and a few remarks on remaining questions are offered. 28 refs.

37451 (DOE/ER/40150–126, pp. 481-486) **Transport and acceleration of low-emittance electron beams.** Henke, H. (CERN, Geneva (Switzerland)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

Linear accelerators for colliders and for free-electron lasers require beams with both high brightness and low emittance. Their transport and acceleration is limited by single-particle effects originating from injection jitter, from the unavoidable position jitter of components, and from chromaticity. Collective phenomena, essentially due to wake fields acting within the bunch, are most severe in the case of high-frequency structures, i.e. a small aperture. Whilst, in the past, the transverse wake-field effects were believed to be

most serious, we know that they can even be beneficial when inducing a corresponding spread in betatron oscillation either by an energy spread along the bunch or by an RF focusing system acting on the bunch scale. This paper evaluates the different effects by simple analytical means after making use of the smooth focusing approximation and the two-particle model. Numerical simulation results are used for verification. 14 refs., 6 figs., 2 tabs.

37452 (DOE/ER/40150–126, pp. 494-500) **Beam phenomena at the interaction point.** Yokoya, Kaoru (National Lab. for High Energy Physics, Ibaraki-ken (Japan)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings*. Order Number DE90007862. Available from NTIS, PC A99/MF A01.

Two major issues of the beam-beam phenomena in linear colliders are the deformation of the bunch (disruption) and the synchrotron radiation (bremsstrahlung) due to the field created by the on-coming beam. In this note we shall report some results of the study on these problems with an emphasis on flat beams. These problems can be studied in two separate steps: first the disruption and then the bremsstrahlung. The energy loss due to the bremsstrahlung may change the process of the luminosity enhancement but this effect can be ignored since we are only interested in the case when the average energy loss is small. The following topics will be discussed in this report: (1) pinch enhancement of the luminosity, (2) kink instability and luminosity reduction due to the displacement of the beam, (3) disruption angle, (4) energy spectrum of electron after collision, and (5) behavior of electrons with large energy loss. 11 refs., 11 figs., 1 tab.

37453 (DOE/SF/00515–T89) **Influence of collective effects on the performance of high-luminosity colliders.** Zisman, M.S. (Lawrence Berkeley Lab., CA (USA)). Stanford Linear Accelerator Center, Menlo Park, CA (USA). 25 May 1990. 49p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098 ;AC03-76SF00515. (ABC–8). Order Number DE90012654. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The design of a high-luminosity electron-positron collider to study B physics is a challenging task from many points of view. In this paper we consider the influence of collective effects on the machine performance; most of our findings are "generic," in the sense that they depend rather weakly on the details of the machine design. Both single-bunch and coupled-bunch instabilities are described and their effects are estimated based upon an example machine design (APIARY-IV). In addition, we examine the possibility of emittance growth from intrabeam scattering and calculate the beam lifetime from both Touschek and gas scattering. We find that the single-bunch instabilities should not lead to difficulty, and that the emittance growth is essentially negligible. At a background gas pressure of 10 nTorr, beam lifetimes of only a few hours are expected. Multibunch growth rates are very severe, even when using an optimized RF system consisting of single-cell, room-temperature RF cavities with geometrical shapes typical of superconducting cavities. Thus, a powerful feedback system will be required. In terms of collective effects, it does not appear that there are any fundamental problems standing in the way of successfully designing and building a high-luminosity B factory. 15 refs., 21 figs., 5 tabs.

37454 (DOE/SF/00515–T95) **IR design and parameters of APIARY VI.** Donald, M.; Garren, A.; Hutton, A.; Sullivan, M. Stanford Linear Accelerator Center, Menlo Park, CA (USA). 29 May 1990. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (ABC–5). Order Number DE90012451. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A layout for head on collisions with flat beams is described which meets the requirements of the B Factory in all of the initial checks we have performed. It must now be refined and subjected to more rigorous tests to ensure that this is really an acceptable solution. In particular, engineering studies on septum quads should be initiated.

37455 (FNAL/C–90/101) **Coherent instability limitations of Fermilab's upgrades.** Bogacz, S.A. Fermi National Accelerator Lab., Batavia, IL (USA). May 1990. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-900603–6: 2. European particle accelerator conference, Nice (France), 11-16 Jun 1990). Order Number DE90012667. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This study is motivated by the proposed upgrades of a whole sequence of Fermilab's accelerators; Linac, Booster, Main Ring or Main Injector and the Tevatron. Two leading high-luminosity collider upgrade scenarios involve larger numbers of colliding bunches of higher intensity. This obviously raises a question of coherent instabilities, which was already quite vital in the present fixed target and collider scenarios. Furthermore, multi-bunch instability limitations due to the resistive wall impedance are studied for the fixed target mode. The same question of coupled bunch instabilities is also addressed for new collider schemes involving large number of colliding bunches (up to 100 on 100 bunches), where the inter-bunch communication may become important. 4 refs.

37456 (FNAL/C–90/102) **Transition crossing with the space charge: The Johnsen and Umstaetter effects.** Bogacz, S.A. Fermi National Accelerator Lab., Batavia, IL (USA). May 1990. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-900603–7: 2. European particle accelerator conference, Nice (France), 11-16 Jun 1990). Order Number DE90012896. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A longitudinal phase-space simulation (ESME) of the transition crossing is carried out (including various collective and single particle effects contributing to the longitudinal emittance blow up). The simulation takes into account the longitudinal space-charge force (bunch length oscillation), the transverse space-charge (the Umstateter effect) and finally the dispersion of the momentum compaction factor (the Johnsen effect). As a result of this simulation one can separate relative strengths of the above mechanisms and study their individual effects on the longitudinal phase-space evolution, especially filamentation of the bunch and formation of a "galaxy-like" pattern. Finally, a simple scheme of the γ_t-jump is implemented as a cure. 14 refs.

37457 (LAL-RT–88-13) **A stochastic model of depolarization enhancement due to large energy spread in electron storage rings.** Buon, J. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Oct 1988. 12p. (CONF-8809484–: 8. International Symposium on High Energy Spin Physics, Minnesota, U (USA), 12-17 Sep 1988). Order Number DE90500811. Available from NTIS (US Sales Only), PC A03/MF A01.

A new semiclassical and stochastic model of spin diffusion is used to obtain numerical predictions for depolarization enhancement due to beam energy spread. It confirms the results of previous models for the synchrotron sidebands of isolated spin resonances. A satisfactory agreement is obtained with the width of a synchrotron satellite observed at SPEAR. For HERA and LEP, at Z_0 energy, the depolarization enhancement is of the order of a few units and increases very rapidly with the energy spread. Large reduction of polarization degree is expected in these rings.

37458 (SAND–90-1677C) **Analysis and modelling of improved accelerating cavities for the Recirculating Linear Accelerator (RLA).** Smith, D.L.; Turman, B.N.; Bennett, L.F. Sandia National Labs., Albuquerque, NM (USA). [1990]. 38p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9006176–2: 19. power modulator symposium, San Diego, CA (USA), Jun 1990). Order Number DE90012586. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

By recirculating a relativistic electron beam (REB) in phase with a repeating accelerating voltage, it is possible to construct compact, efficient, high voltage gradient, linear induction accelerators (LIA). Concerns about energy spreads due to degradation of our 1.1-MV, 34-ns duration accelerating activity repeating pulse shapes have resulted in our improving the 24-switch trigger system for the ET-2 cavity, and identifying critical factors in the cavity design that affect the pulse shape. We summarize the improvements (completed and proposed) for the existing ET-2 cavity pulsed power and the status of our design analysis and modelling for the new four-pass accelerating cavities that could produce a 20-MeV REB for RLA. 14 refs., 24 figs.

37459 (SLAC-CN-376) **Determination of ϵ, β, α from an arbitrary number of beam size measurements.** Seeman, J. Stanford Linear Accelerator Center, Menlo Park, CA (USA). 23 Apr 1990. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. Order Number DE90012449. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This note describes how the emittance ϵ and the betatron functions β and α of a beam in an uncoupled high energy linac or transport line are extracted from an arbitrary number ($\geq$3) of beam size measurements separated by various betatron phase advances. It is assumed that the beam sizes have no contributions from dispersion, intentional or otherwise.

37460 (UCRL-CR-104212) **Theoretical simulations of the synchrotron instability in high gain, high power free electron lasers: Final report.** Colson, W.B. (Berkeley Research Associates, Inc., CA (USA)). Lawrence Livermore National Lab., CA (USA). 1985. 19p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (BRA-89-341R). Order Number DE90013065. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The ELF FEL experiments at LLNL in 1985 provide the first results of a free electron laser (FEL) operating in the high-current, high-gain, high-efficiency regime. Initial experiments measured 15.6dB/m gain at $\lambda \approx$ 8mm radiation wavelength. Much of the understanding of the ELF experiment comes from simulations like LLNL's FRED that are run on large CRAY computers. In this brief study, a simpler model is used to explain weak-field gain and saturation. Several physical quantities are expressed in a useful dimensionless form, and serve to relate the ELF FEL to other FEL configurations and to future amplifier designs. The trapped-particle instability is explored for parameters close to the original experiments, and parameters representative of future improvements. 8 refs., 9 figs.

37461 **Electron energy spectrum and maximum disruption angle under multi-photon bremsstrahlung.** Yokoya, Kaoru (National Laboratory for High Energy Physics, Tsukuba (Japan)); Chen, Pisin. pp. 1438-1440 of Proceedings of the 1989 IEEE (Institute of Electrical and Electronics Engineers) particle accelerator conference. Volume 3. Bennett, F.; Kopta, J. (eds.). Institute of Electrical and Electronics Engineers, New York, NY (US) (1989). (CONF-890335--Vol.3: 1989 IEEE particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989).

The synchrotron radiation, called bremsstrahlung, due to the beam-beam force is one of the major limitations of the performance for the next generation linear colliders. In addition to the average loss, the electron energy spectrum also provides crucial information. The final electron energy spectrum under multi-photon beamstrahlung process is derived analytically in the classical and the intermediate regimes. The maximum disruption angle from the low energy tail of the spectrum is also estimated. The results are then applied to the TLC and the CLIC parameters. 6 refs., 1 fig., 1 tab.

37462 **Beam dynamics issues in linear colliders.** Seeman, J.T. (Stanford Univ., CA (USA)). pp. 1736-1740 of Proceedings of the 1989 IEEE (Institute of Electrical and Electronics Engineers) particle accelerator conference. Volume 3. Bennett, F.; Kopta, J. (eds.). Institute of Electrical and Electronics Engineers, New York, NY (US) (1989). (CONF-890335--Vol.3: 1989 IEEE particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989).

The primary goal of present and future linear colliders is to maximize the integrated luminosity for the experimental program. Beam dynamics plays a central role in the maximization of integrated luminosity. It is the major issue in the production of small beam sizes and low experimental backgrounds and is also an important factor in the production of particle numbers, in the acceleration process, and in the number of bunches. The beam dynamics effects on bunches which are extracted from the damping rings, accelerated in the linac, collimated, momentum analyzed, and finally delivered to the final focus are reviewed. The effects of bunch compression, transverse and longitudinal wakefields, BNS damping, energy definition, dispersion, emittance, bunch aspect ratio, feedback, and stability are all important. 11 refs.

37463 **Overcoming intrinsic and synchrotron depolarizing resonances with a Siberian snake.** Goodwin, J.E. (Indiana University Cyclotron Facility, Bloomington, Indiana 47408 (USA)); Meyer, H.; Minty, M.G.; Pancella, P.V.; Pollock, R.E.; Rinckel, T.; Ross, M.A.; Sperisen, F.; Stephenson, E.J.; von Przewoski, B. *Physical Review Letters (USA)*, 64(23): 2779-2782 (4 Jun 1990).

We overcame the strong $G\gamma=-3+\nu_y$ intrinsic depolarizing resonance using a Siberian snake acting on a stored beam of 177-MeV polarized protons at the Indiana University Cooler Ring. We also saw the first evidence for a synchrotron depolarizing resonance in a proton ring. Two synchrotron resonances were studied by varying the rf accelerating voltage and the imperfection field at 104 MeV. The Siberian snake also overcame these synchrotron depolarizing resonances.

37464 **Theory of multistage intense ion-beam acceleration.** Slutz, S.A. (Sandia National Laboratories, Pulsed Power Theory Division, Albuquerque, New Mexico 87185 (USA)); Desjarlais, M.P. *Journal of Applied Physics (USA)*, 67(11): 6705-6717 (1 Jun 1990). DOE Contract AC04-76DP00789.

We present an analytic theory for magnetically insulated, multistage acceleration of high-intensity ion beams, where the diamagnetic effect due to electron flow is important. Our theory is an extension of the single-stage diode theory developed by Desjarlais [Phys. Rev. Lett. **59**, 2295 (1987)], based on a self-consistent calculation of the virtual cathode position, which has been successful in modeling Applied-*B* ion diode experiments on several accelerators. The new theory incorporates a finite injection energy qW for the beam ions. We have found a critical voltage $V_1(W)$ that corresponds to V_* of the single-stage theory. As the voltage approaches V_1, unlimited beam-current density can penetrate the gap without the formation of a virtual anode because the dynamic gap goes to zero. At voltages lower than V_1, a sufficiently large injection current will cause the formation of a virtual anode in response to the large beam space charge. Furthermore, we have found that unlimited beam current can penetrate an accelerating gap operated above a second critical voltage $V_2(W)$. At voltages below V_2, there is a maximum steady-state current that can be transmitted through the gap. The critical voltage V_2 is smaller than V_1 and is unique to the multistage theory. If fluctuations allow electron transport across magnetic field lines so that any virtual anode is neutralized, V_2 goes to zero for all beam injection energies. This effect can be used to test the importance of field fluctuations on the electron dynamics in magnetically insulated ion acceleration gaps.

4303 Auxiliaries and Components

Refer also to citation(s) 37280, 37410, 37430, 37433, 37434, 37435, 37448, 37520, 37649, 37650, 37669, 37707, 38069, 38070, 38281, 38283, 38297, 38303

37465 (BONN-IR-89-15) **Construction and test of the Bonn frozen spin target.** Dutz, H. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Apr 1989. 89p. (In German). Order Number DE90501238. Available from NTIS (US Sales Only), PC A05/MF A01.

For $\gamma N \rightarrow \Pi N$ and $\gamma d \rightarrow pn$ scattering experiments at the PHOENICS detector, a new 'bonn frozen spin target' (BOFROST) is developed. The target with a maximum volume of 30 cm^3 is cooled in a vertical ^3He-^4He dilution kryostat. The lowest temperature of the dilution kryostat in the frozen spin mode should be 50 mk. In a first stage, the magnet system consist of two superconducting solenoids: A polarisation magnet with a maximum field of 7 T with a homogenity of 10^{-5} over the target area and a 'vertical holding' magnet with a maximum field in the target area of 0.57 T. This work describes the construction and the set-up of the 'frozen spin target' in the laboratory and the first tests of the dilution kryostat and the superconducting magnet system. (orig.).

37466 (DOE/ER/40150-126, pp. 199-202) **Superconducting accelerating structures for high-current ion beams.** Delayen, J.R. (Argonne National Lab., IL (USA)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049--: 14.

linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

A series of superconducting structures for the acceleration of high-current ion beams is being developed, and two prototype Nb cavities are under construction. These cavities operate in a frequency velocity range which, for superconducting structures, has been little explored: frequencies of 0.4 GHz to more than 1 GHz, and velocities of 0.1 to 0.5 c. Issues discussed include: need for strong beam loading ($\sim 10^4$), need for strong focusing elements located close to the cavities, minimization of beam impingement and beam instabilities. 9 refs., 4 figs.

37467 (DOE/ER/40150–126, pp. 227-230) **Prospects for RF application of high TC superconductors.** Padamsee, H. (Cornell Univ., Ithaca, NY (USA)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

RF measurements from 0.1 to 150 GHz on high Tc superconductors in bulk ceramic and thin film forms show that losses at the present level of materials preparation techniques are high and increase rapidly with increasing RF surface magnetic field. At this stage the new superconductors are not competitive with Nb at liquid He temperature or with copper at room temperature. On the other hand, superior RF properties revealed by measurements on crystal YBaCuO indicate that the problems are not intrinsic to high Tc superconductors. The authors are therefore encouraged to expect that as new fabrication techniques emerge to conquer the prevalent problems of grain orientation, intergrain impurities, impurity phases, and oxygen stoichiometry, microwave applications of high Tc oxide superconductors will eventually be realized. 20 refs., 3 figs., 1 tab.

37468 (DOE/ER/40150–126, pp. 382-384) **Modular magnet current regulator.** Dobeck, N. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)); Burtner, G.; LaMora, R. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

A modular power regulation system has been developed to handle the many low-power correction and focusing magnets used for beam transport. The system consists of numerous 32-channel assemblies, each containing a bulk power supply, CAMAC control crate, and card cage space for current regulators. Regulators are linear, bipolar modules capable of parallel connection for higher power output. 4 figs.

37469 (DOE/ER/40150–126, pp. 388-390) **Requirements for longitudinal HOM damping in superconducting recirculating linacs.** Bisognano, J.J. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)); Fripp, M.L. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. DOE Contract AC05-84ER40150. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

Transverse beam breakup provides the primary current limitation in the operation of superconducting recirculating linacs and requires the significant damping of transverse-deflecting higher order modes. The need to damp the coexisting longitudinal HOMs in these nominally isochronous machines, however, is not as clear. Isochronicity implies that energy variations induced by excitation of longitudinal modes do not translate directly into position and current modulations. Such modulations, if present, could enhance the initial excitation, effectively closing a potentially unstable feedback loop. Design optimization of cavity structures may suggest that no longitudinal damping be provided. On the other hand, easing of the isochronicity requirement may provide desired flexibility in lattice design. In this note, limits are placed on the requirements for longitudinal HOM damping and on the tolerances for isochronicity which are driven by possible longitudinal multipass phenomena. 2 refs., 1 fig.

37470 (DOE/ER/40150–126, pp. 397-399) **Does UHV annealing above 1100C as a final surface treatment reduce field emission loading in superconducting cavities.** Padamsee, H. (Cornell Univ., Ithaca, NY (USA)); Gendreau, K.; Hartung, W.; Kirchgessner, J.; Moffat, D.; Noer, R.; Rubin, D.L.; Sears, J.; Shu, Q.S. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

Research on advancing high field capability of Nb microwave cavities for application to future e^+e^- colliders is being conducted with 1-cell 1500 MHz elliptical cavities, equipped with a high speed temperature mapping diagnostic system. Above 10 MeV/m accelerating field, field emission severely loads cavity Q. One of the most interesting questions addressed regarding field emission (FE) in superconducting cavities is whether heat treatment (HT) reduces emission and permits higher fields, as suggested by dc FE experiments on Nb surfaces, conducted at the U. of Geneva. Comparison between heat treated and chemically treated cavities gives an encouraging picture for the benefits of HT. On the average, 75% higher fields are possible, and the best surface electric and magnetic fields reached were 1260 Oe and 50 MV/m. 8 refs., 5 figs.

37471 (DOE/ER/40150–126, pp. 470-474) **Model-based expert systems for linac computer controls.** Lee, M.J. (Stanford Univ., CA (USA)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. DOE Contract AC03-76SF00515. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

The use of machine modeling and beam simulation programs for the control of accelerator operation has become standard practice. The success of a model-based control operation depends on how the parameter to be controlled is measured, how the measured data is analyzed, how the result of the analysis is interpreted, and how a solution is implemented. There is considerable interest in applying expert systems technology that can automate all of these processes. The design of an expert system to control the beam trajectory in linear accelerators will be discussed as an illustration of this approach. 4 figs., 1 tab.

37472 (DOE/ER/40150–126, pp. 430-431) **A high resolution beam profile monitor using Bremsstrahlung.** Norem, J. (Argonne National Lab., IL (USA)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. DOE Contract W-31-109-ENG-38. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

The development of efficient high energy linear colliders in the 1 TeV range requires final focus systems capable of producing beam spot sizes on the order of 1 - 20 nm, about three orders of magnitude smaller than those produced at the SLC. Although beam line designs exist which can, in principle, produce the required optics, the construction of quadrupoles with the size and precision required will be challenging. Field errors in these quads must be small and should be verified experimentally, which is difficult with existing technology. This paper describes a proposal to use bremsstrahlung from heavy targets to measure high energy beam profiles and positions with a resolution approaching a few nm. The method is also applicable to tests of other final focus systems (flat beams, plasma lenses) at lower energies. 6 refs., 3 figs., 1 tab.

37473 (DOE/ER/40150–126, pp. 528-530) **An RF-driven lasertron.** Tallerico, P.J. (Los Alamos National Lab., NM (USA));

Sheffield, R.L.; Cornelius, W.D.; Gray, E.R.; Wilson, M.T.; Nguyen, D.C.; Meier, K.L.; Stockley, R.L. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings*. Order Number DE90007862. Available from NTIS, PC A99/MF A01.

An rf-driven lasertron has been built and is being tested. It is designed to produce over 1 MW of power at 1.3 GHz, with over 60% conversion efficiency between the beam's kinetic energy and microwaves. The design and experiment are discussed, and calculations are presented that show lasertrons can operate at frequencies up to 20 GHz. 3 refs., 5 figs.

37474 (DOE/ER/40150–126, pp. 503-507) **A review of Gyroklystrons and a cost estimate for a Gyroklystron-driven supercollider.** Granatstein, V.L. (Univ. of Maryland, College Park (USA)); Lawson, W.; Mondelli, A.; Chernin, D. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings*. Order Number DE90007862. Available from NTIS, PC A99/MF A01.

Gyroklystrons avoid the small gap cavity structures which might cause breakdown problems in conventional klystrons. As a result it is believed gyroklystron performance will scale to higher power at higher frequency. Attainable peak power in a gyroklystron amplifier is estimated to be 105 MW at 17.14 GHz. The application of such amplifiers to driving a linear collider such as the TLC (1 TeV center of mass energy, 2.5 km length per linac) is shown to be optimized for an accelerator field length of 3 m, corresponding to a gyroklystron pulse length of 1.8 μs (pulse compression by a factor of 16 is assumed). The number of gyroklystrons required per linac would be 833. The cost of the RF system for a gyroklystron-driven TLC is estimated to be $0.65 billion. 17 refs., 3 figs., 1 tab.

37475 (DOE/ER/40150–126, pp. 508-513) **Relativistic klystron research for linear colliders.** Allen, M.A.; Callin, R.S.; Deruyter, H.; Eppley, K.R.; Fant, K.S.; Fowkes, W.R.; Herrmannsfeldt, W.B.; Higo, T.; Hoag, H.A.; Koontz, R.F. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings*. Order Number DE90007862. Available from NTIS, PC A99/MF A01.

Relativistic klystrons are being developed as a power source for high gradient accelerator applications which include large linear electron-positron colliders, compact accelerators, and FEL sources. The authors have attained 200MW peak power at 11.4 GHz from a relativistic klystron, and 140 MV/m longitudinal gradient in a short 11.4 GHz accelerator section. They report here on the design of our relativistic klystrons, the results of our experiments so far, and some of our plans for the near future. 5 refs., 9 figs., 1 tab.

37476 (DOE/ER/40150–126, pp. 547-549) **High repetition rate kickers for linear colliders.** Heifets, S.A. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)); Rossmanith, R. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. DOE Contract AC05-84ER40150. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings*. Order Number DE90007862. Available from NTIS, PC A99/MF A01.

It was shown in a previous paper that kickers with a high repetition rate can be designed by combining several cavities operating in a deflecting mode. In this paper the authors simplify this idea by showing that such kickers can be built also with one cavity or with an assembly of coupled cavities operating at several frequencies. They also demonstrate that this concept can be used for accelerating cavities. The electrical breakdown limit for such multimode accelerating cavities will be significantly higher than conventional single-mode cavities; therefore higher acceleration gradients, e.g., for linear colliders, can be achieved. 3 refs., 4 figs.

37477 (DOE/ER/40150–126, pp. 556-558) **Design and fabrication studies of high gradient accelerating structures for the CERN linear collider (CLIC).** Wilson, I. (CERN, Geneva (Switzerland)); Schnell, W.; Henke, H. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings*. Order Number DE90007862. Available from NTIS, PC A99/MF A01.

An energy of 1 TeV per beam will be obtained in CLIC by classical RF acceleration using a high gradient disc loaded waveguide operating at 29 GHz. The basic parameters and resulting technical requirements of such a structure are given together with a conceptual design of a possible engineering solution. Special design features and difficulties associated with the two most likely ways of fabrication are discussed and first results from prototype tests are given. Attention is drawn to the possibility of surface damage by fatigue from induced cyclic stresses in pulsed operation for excessive electric field gradients. A beam-derived signal from a microwave position pickup incorporated into the main accelerating sections is foreseen for alignment purposes. 8 refs., 9 figs., 2 tabs.

37478 (DOE/ER/40150–126, pp. 589-591) **Transient analysis of multicavity klystrons.** Lavine, T.L. (Stanford Univ., CA (USA)); Miller, R.H.; Morton, P.L.; Ruth, R.D. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. DOE Contract AC03-76SF00515. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings*. Order Number DE90007862. Available from NTIS, PC A99/MF A01.

The authors describe a model for analytic analysis of transients in multicavity klystron output power and phase. Cavities are modeled as resonant circuits, while bunching of the beam is modeled using linear space-charge wave theory. Their analysis has been implemented in a computer program which they use in designing multicavity klystrons with stable output power and phase. They present as examples transient analyses of a relativistic klystron using a magnetic pulse compression modulator, and of a conventional klystron designed to use phase shifting techniques for RF pulse compression. 4 refs., 4 figs.

37479 (DOE/ER/40150–126, pp. 623-624) **The use of a single source to drive a binary peak power multiplier.** Latham, P.E. (Univ. of Maryland, College Park (USA)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings*. Order Number DE90007862. Available from NTIS, PC A99/MF A01.

The binary power multiplier (BPM) recently proposed by Farkas requires a pair of RF inputs whose phases are set independently. In this note, a method is presented in which a single source may be used to drive a BPM. Phase coding occurs at the source input where the power is low and phase switching is straightforward. There is a loss in energy of around 25% but only a small reduction in peak power. 4 refs., 3 figs.

37480 (DOE/ER/40150–126, pp. 640-642) **Short RF pulse propagation in a traveling wave structure.** Ferrucci, L. (Universita di Milano (Italy)); Pagani, C.; Serafini, L. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings*. Order Number DE90007862. Available from NTIS, PC A99/MF A01.

The authors present in this paper some numerical results on the propagation of RF pulses inside an accelerating structure of the iris loaded, constant impedance, type. Their aim is to evaluate the possibility to fill an accelerating structure with a train of short RF

pulses (shorter than the filling-time τ_f), instead of a single RF pulse whose time-duration is of the order of τ_f. 4 refs., 5 figs.

37481 (DOE/ER/40150–126, pp. 643-645) **Design considerations of high peak power gyroklystrons for linear colliders.** Lawson, W.; Latham, P.E.; Calame, J.; Skopec, M.; Welsh, D.; Hogan, B.; Wang, W.; Read, M.E.; Striffler, C.D.; Reiser, M. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

In this paper, the final preparations for bringing the University of Maryland's 10 GHz, 30 MW gyroklystron experiment on-line are discussed. The authors explain the enhanced circuit modeling and present a two cavity design which predicts an efficiency of 33% and a gain of 27 dB with the simulated beam parameters. They describe initial operation of the modulator and electron gun and detail the experimental design of the system. Finally, they present plans for a high gain gyroklystron circuit and discuss scaling considerations for producing powers in excess of 100 MW in the frequency range 10-30 GHz. 7 refs., 3 figs., 2 tabs.

37482 (DOE/ER/40150–126, pp. 631-633) **The new injector design for the upgraded RADLAC-II linear accelerator.** Mazarakis, M.G. (Sandia National Labs., Albuquerque, NM (USA)); Poukey, J.W.; Shope, S.L.; Hasti, D.E.; Frost, C.A.; Leifeste, G.T.; Smith, D.L. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. DOE Contract AC04-76DP00789. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

The cathode field shaper, shank assembly, and magnetic field profile have been redesigned for the upgraded RADLAC-II configuration. The new design incorporates our most recent experimental observations, JASON code analysis, and simulation results with the newest version of particle-in-cell (PIC) code MAGIC. A conical field shaper was selected that starts at the cathode end plate with a 10-cm diameter cylinder and tapers smoothly to the cathode tip. The field shaper is 1-m long. Three interchangeable cone tips provide for different diameter cathode tips (1.2 cm, 1.9 cm, and 2.5 cm). The simulations show that a 40 to 50-kA annular cold beam can be produced with an rms transverse velocity component $\beta\perp$ = 0.06 and a radius r = 0.85 cm. The total cathode shank losses are drastically reduced and the previously observed beam halo completely eliminated. Experimental results are in good agreement with the design goals. 7 refs., 9 figs.

37483 (DOE/ER/40150–126, pp. 684-488) **An FEL power source for a TeV linear collider.** Hopkins, D.B. (Lawrence Berkeley Lab., CA (USA)); Hoyer, E.H.; Halbach, K.; Sessler, A.M.; Barletta, W.A.; Jong, R.A.; Reginato, L.L.; Yu, S.S.; Bayless, J.R.; Palmer, R.B. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. DOE Contract AC03-76SF00515. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings.* Order Number DE90007862. Available from NTIS, PC A99/MF A01.

In this paper we consider the design of a power source for a linear collider. The authors take a conservative approach and hence extrapolate as little as possible from present experience. Thus they establish a straw man; i.e. a design which serves as an existence proof of a power source for a TeV collider. For the power sources they consider FELs (free electron lasers). 5 refs., 13 figs., 4 tabs.

37484 (DOE/SF/00515–T90) **Sizing the vacuum chambers conservatively.** Hutton, A. Stanford Linear Accelerator Center, Menlo Park, CA (USA). 21 May 1990. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (ABC–6). Order Number DE90012652. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This note will examine many different scenarios, both optimistic and pessimistic, for the performance of the B Factory. The primary reason for this is to establish limits for the emittances in the two rings. This information will be needed to ensure that the vacuum chambers are sized to permit the maximum flexibility. 3 refs., 3 tabs.

37485 (DOE/SF/00515–T91) **B-Factory mechanical utilities operation without SLC.** Skaggs, B. Stanford Linear Accelerator Center, Menlo Park, CA (USA). 25 May 1990. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (ABC–7). Order Number DE90012653. Available from NTIS, PC A03/MF A01; OSTI; INIS.

This paper contains cost estimates and calculations of a cooling systems for the B-Factor collider. (LSP)

37486 (KEK–89-12, pp. 100-123) **Consideration on feasibilities of double polarization experiments with polarized electron (or photon) beam and polarized target.** Nakanishi, Tsutomu (Nagoya Univ. (Japan). Dept. of Physics). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Sep 1989. (CONF-8810498–: Workshop on the experiments by polarized proton and electron beams, Tsukuba (Japan), 27-28 Oct 1988). In *Proceedings of the workshop on the experiments by polarized proton and electron beams.* Order Number DE90777829. Available from NTIS (US Sales Only), PC A11/MF A01.

The physics interests are shortly reviewed for measuring the double spin-observables emplying both of the polarized e^- (or γ) beam (PB) and the polarized target (PT). It is shown that such a experiment has already enough feasibility with the present technology if it is compatible with relatively low intensity beam. But the experiments at high q^2 region requires intense beam and much improvements of apparatus are necessary for both of PB and PT. Here, such problems are discussed and the guide-lines to countermeasure them are given. (author).

37487 (KEK–89-12, pp. 134-140) **Test apparatus of GaAs spin polarized electron source at Nagoya University.** Takeda, Yasutoshi (Nagoya Univ. (Japan). Dept. of Physics); Nakanishi, Tsutomu. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Sep 1989. (CONF-8810498–: Workshop on the experiments by polarized proton and electron beams, Tsukuba (Japan), 27-28 Oct 1988). In *Proceedings of the workshop on the experiments by polarized proton and electron beams.* Order Number DE90777829. Available from NTIS (US Sales Only), PC A11/MF A01.

Here, we report briefly the development of our GaAs spin polarized electron source (PES) system. The electron spin polarization (ESP) of 31.2 $\pm$ 0.8 % was obtained at room temperature after eliminating the contamination of secondary electrons which were intermixed to the primary beam at the 100 KV accelerator of Mott spin analyzer. (author).

37488 (KEK–89-16) **Performance of BL10B and a simple performance test for EXAFS stations.** Nomura, Masaharu; Koyama, Atsushi. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1989. 21p. Order Number DE90798716. Available from NTIS (US Sales Only), PC A03/MF A01.

Experimental station BL10B can supply ca. 10^9 photons/s with ΔE = 1 eV at E = 9 keV when the store current is 300 mA, making it very suitable for EXAFS experiments. The reproducibility of the energy axis is better than 0.0005 deg within a half day. The content of third-order harmonics is 7.1 x 10^{-4} at 9 keV, which is sufficiently small for normal EXAFS experiments. A new simple, sensitive qualitative performance test is proposed. (author).

37489 (NAC-AR–88-01, pp. 4-10) **The injector cyclotrons.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

The SPC1 injector cyclotron has been running very reliably. Beam interruptions due to injector failures amounted to only 6.2% of the total running time. A few minor modifications were made to improve the reliability even more, and the control of the rf-system has been automated to a point where almost no action is required from the operators during runs. Progress with the second injector

cyclotron SPC2 has been slower than originally planned. Final preparations are being made for the magnetic field mapping of the main magnet. Most of the calculations for the central region have been completed, but the design of the central region has been delayed. Manufacture of the extraction system, which is basically the same as that of SPC1, the diagnostic system and the design of the vacuum control system are progressing well. The ECR-source has been delivered and is being installed. Manufacturing of the ion source for polarized protons and deuterons has been completed and the source is now being tested at the factory. Delivery is expected by the end of 1988. 1 fig., 2 refs., 2 tabs.

37490 (NAC-AR–88-01, pp. 44-49) **Beam transport: Beam diagnostics for beamlines.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

The beam diagnostic components for both the transfer and the high-energy beamlines perform well except for some of the scanners whose noise pick-up has become a problem, especially at low beam intensities. This noise pick-up is primarily due to deterioration of the bearings in the scanner. At some locations in the high-energy beamlines, scanners were replaced by harps as the scanners proved to be practically useless for the low-intensity beams required in the experimental areas. The slits in the low-energy beamline, which are not water-cooled, have to be repaired at regular intervals because of vacuum leaks. Overheating causes the ceramic feedthroughs to deteriorate resulting in the vacuum leaks. Water-cooled slits have been ordered to replace the existing slits which will later be used in the beamlines associated with the second injector cyclotron SPC2. The current-measurement system will be slightly modified and should then be much more reliable. 3 figs.

37491 (NAC-AR–88-01, pp. 134-146) **Radioisotope production.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

The trial production runs started in the previous report period were continued and have been extended to ^{67}Ga, ^{81}Rb/^{81m}Kr and ^{111}In, the production of which will be taken over from the Pretoria cyclotron at the end of this year, when that machine is scheduled to be shut down. After commissioning of the target water cooling system and the helium cooling system for beam foil windows at the beginning of this year, these production runs could also be extended to high beam currents (up to 50 μA). Test consignments of a number of products have been supplied to various potential future users, and ^{123}I, in the form of Na^{123}I capsules as well as ^{123}I-sodium hippurate, and ^{52}Fe-citrate have actually been used with success in trial diagnostic studies on patients. A procedure for labelling IPPA and 3-IPMPA with ^{123}I has been developed, while initial work has also been done on the radioiodination of monoclonal antifibrine antibodies. The last major facility needed for the commencement of the routine radioisotope production programme, namely the multiple-target facility, is now ready for installation in the production vault within the next few weeks, and routine production runs are expected to start in November 1988. 4 figs., 18 refs.

37492 (NAC-AR–89-01, pp. 39-43) **The injector cyclotrons.** National Accelerator Centre, Faure (South Africa). 1989. In *Annual report June 1989.* Available from the National Accelerator Centre, PO Box 72, Faure, 7131, South Africa.

The injector cyclotron SPC1 again proved itself to be a very reliable machine. During the past year only about 4% of the beam interruptions were due to injector failures. Even during scheduled shutdowns very little time was devoted to SPC1. Progress with SPC2 has been slow owing to lack of manpower and the higher priority given to other tasks. However, the magnet is now ready for field mapping, and the software for this is completed. The resonators are on site, but the dees have still to be manufactured. The extraction elements have been manufactured, and software for the vacuum control system is progressing well. The ECR source has been delivered, but not yet tested, while the spin-aligned ion source is still undergoing tests prior to delivery. 2 figs., 5 refs.

37493 (NAC-AR–89-01, pp. 17-26) **The separated-sector cyclotron: beam transport: Operation and development.** National Accelerator Centre, Faure (South Africa). 1989. In *Annual report June 1989.* Available from the National Accelerator Centre, PO Box 72, Faure, 7131, South Africa.

Few changes have been made to the existing beam transport lines, and operation has become a fairly routine matter. A 'pepper-pot' beam attenuator has been installed in the transfer beamline from SPC1 to the separated-sector cyclotron (SSC) to aid in tuning high-intensity beams. The beam swinger manufacture is now virtually complete, and delivery should take place within the next few weeks. The K=600 spectrometer magnets have now been re-assembled after re-machining of the entrance and exit faces of the pole pieces. The computer program which drives the mapping arm has been expanded considerably to include automatic calibration of the 16 Hall probes, user-defined mapping areas with irregular sides, visual display of probe position, etc. The proposed changes to the isotope beamline have been implemented, and the line is consequently much easier to operate. Routine switching between isotope and radiotherapy beamlines can now be done within 15 seconds. Additional quadrupole magnets have been delivered, and a quadrupole doublet has been installed on the neutron source beamline. 9 figs., 3 refs.

37494 (NAC-AR–89-01, pp. 59-64) **Research in the physical sciences: Low-energy nuclear physics.** National Accelerator Centre, Faure (South Africa). 1989. In *Annual report June 1989.* Available from the National Accelerator Centre, PO Box 72, Faure, 7131, South Africa.

Experiments regarding nuclear level structure parameters and nuclear interactions were performed using the 6 MV Van de Graaff accelerator. Their aim was to extend the available data base of nuclear level structure parameters and to provide information about nuclear interactions and include firstly reactions involving fast neutrons: nuclear structure studies with proton pick-up reactions; and secondly charged-particle induced reactions: level structure, gamma-ray branching and mean lifetimes; mixing ratios from angular correlation measurements; and spins of excited states in ^{55}Mn, ^{22}Ne, ^{29}Al, ^{51}V and ^{54}Cr. 2 figs., 1 tab., 11 refs.

37495 (NAC-AR–89-01, pp. 65-83) **Research in the physical sciences: Medium-energy nuclear physics.** National Accelerator Centre, Faure (South Africa). 1989. In *Annual report June 1989.* Available from the National Accelerator Centre, PO Box 72, Faure, 7131, South Africa.

Experiments in medium-energy nuclear physics include: Differential cross-section for n-p radiative capture at E_n = 63-123 MeV. Inelastic continuum spectra from ^{12}C, ^{58}Ni, ^{100}Mo and ^{197}Au at incident energies between 100 and 200 MeV; Energy spectra for ^{12}C(p,p') at 90 and 120 MeV incident energy; Coincidence measurements of energetic protons at backward angles in proton-nucleus collisions at 200 MeV; Nuclear reactions with 50 MeV alpha particles. Coincident proton decay of the continuum induced by 200 MeV protons on ^{12}C; the reaction ^{4}He(p,p'x) for x=p,d,t, ^{3}He, at an incident energy of 100 MeV; and radiative-capture of medium energy protons. Technical developments in data handling are also mentioned and a focal-plane detector for the K=600 spectrometer is discussed. 11 figs., 31 refs.

37496 (NAC-AR–89-01, pp. 209-222) **Radioisotope production and radioactivity standards: Radioisotope production.** National Accelerator Centre, Faure (South Africa). 1989. In *Annual report June 1989.* Available from the National Accelerator Centre, PO Box 72, Faure, 7131, South Africa.

The Pretoria cyclotron was closed down as planned on 16 November 1988, and the routine production of some medical radioisotopes was transferred without interruption to the Faure facilities. The switch-over took place smoothly apart from some inevitable teething problems. The main aim during the past year has been to get the new equipment, facilities and production procedures ready for the routine production programme. The control systems, target-preparation and target-handling facilities, cooling systems and hot cells were completed and commissioned. The chemical processing and radiopharmaceutical manufacturing facilities were also established. Routine production of ^{67}Ga-citrate, ^{81}Rb/^{81m}Kr generators and ^{123}I-sodium iodide was started. Studies and development work were carried out on the production of ^{67}Ga, ^{81}Rb using a gaseous target, ^{111}In, ^{123}I-labelled compounds such

as ^{123}I-hippurate, ^{123}I-MIBG, ^{123}I-IAMP and ^{123}I-IPPA as well as ^{201}Tl. Further bio-evaluation studies were performed on ^{123}I-hippurate and ^{123}I-MIBG, and liason with the Medicines Control Council concerning registration of new radioisotope products as medicines was continued. 6 figs., 3 tabs., 7 refs.

37497 (RCNP-P–107, pp. 90-92) **A rotating catcher system (CAROT) for a decay study of projectile fragmentation.** Adachi, M. (Tokyo Inst. of Tech. (Japan)). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'*. Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

A rotating catcher system (CAROT), which is designed for a decay study of exotic nuclei produced by projectile fragmentation with a beam from RIKEN Ring Cyclotron, is introduced. (author).

37498 (RCNP-P–107, pp. 224-227) **Construction of the RCNP polarized heavy ion source, 'HISPANIOLA'.** Tanaka, M. (Kobe Tokiwa Junior Coll. (Japan)); Ohshima, T.; Katori, K.; Fujiwara, M.; Itahashi, T.; Ogata, H.; Kondo, M. Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'*. Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

Construction of the RCNP polarized heavy ion source is presented. Principle of the polarization production is based on charge and spin exchange collisions between highly stripped heavy ions and polarized Na vapor. A 2.45 GHz ECR ion source produces highly stripped heavy ions. A single mode ring dye- laser serves in producing Na polarization by means of an optical pumping. As a first step of our project, the production of polarized ^{3}He is primarily scheduled. (author).

37499 (SAND–90-7003) **STL [Simulation Technology Laboratory] Global Control System, technical reference.** Mitchell, R.A. (Ktech Corp., Albuquerque, NM (USA)). Sandia National Labs., Albuquerque, NM (USA); Ktech Corp., Albuquerque, NM (USA). 30 Jan 1990. 48p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE90011258. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report describes the major hardware and software components of the Global Control System (GCS) at the Simulation Technology Laboratory (STL) at Sandia National Laboratories. The GCS presently controls the transfer of oil and water between seven storage tanks and eight accelerator tanks. This report is intended to be a general introduction to the system for engineers and technicians involved in the maintenance and modifications of the system and may also be useful to people interested in designing and constructing a similar system. The scope of this report is to mention the hardware and software systems that are used that are common to the HERMES III and GCS control systems and to describe in detail the hardware and software that is unique to the GCS. 12 refs., 8 figs.

37500 (TRI-PP–90-8) **The laser system of the optically pumped ion source at TRIUMF.** Levy, C.D.P. (TRIUMF, Vancouver, BC (Canada)); Burge, R.; Mouat, M.; Sarkar, S.; Schmor, P.W.; Wilkinson, N.; Dehaven, R.; Zelenskii, A.N. TRIUMF, Vancouver, BC (Canada). Feb 1990. 7p. (CONF-900289–5: International workshop on the polarized ion sources and polarized gas jets, Tsukuba-Shi (Japan), 12-17 Feb 1990). Order Number DE90013102. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

The optically pumped ion source at TRIUMF relies on laser optical pumping of a sodium vapour charge exchange cell for polarization. The laser system is described. 3 refs., 6 figs.

37501 (UCRL–100089) **Relativistic klystron research for linear colliders.** Allen, M.A.; Callin, R.S.; Deruyter, H.; Eppley, K.R.; Fant, K.S.; Fowkes, W.R.; Herrmannsfeldt, W.B.; Higo, T.; Hoag, H.A.; Koontz, R.F. Lawrence Livermore National Lab., CA (USA). Dec 1988. 6p. Sponsored by US-Japan High Energy Physics Collaboration Treaty. DOE Contract W-7405-ENG-48 ;AC03-76SF00098 ;AC03-76SF00515. (CONF-8806243–47: DPF summer study: Snowmass '88: high energy physics in the 1990s; Division of particles and fields summer study: Snowmass '88 and linear accelerator conference, Snowmass, CO (USA); Williamsburg, VA (USA), 27 Jun - 15 jul 1988; 27 jun - Order Number DE90012986. Available from NTIS, PC A02/MF A01 - OSTI.

Relativistic klystrons are being developed as a power source for high gradient accelerator applications which include large linear electron-positron colliders, compact accelerators, and FEL sources. We have attained 200MW peak power at 11.4GHz from a relativistic klystron, and 140MV/m longitudinal gradient in a short 11.4GHz accelerator section. We report here on the design of our relativistic klystrons, the results of our experiments so far, and some of our plans for the near future. 5 refs., 9 figs.

37502 (UCRL–101476) **A fast injection system with a superconducting accumulator ring for a tau charm factory.** Barletta, W.A. Lawrence Livermore National Lab., CA (USA). 11 Jul 1989. 7p. Sponsored by European Organization for Nuclear Research. DOE Contract W-7405-ENG-48. (CONF-8905144–17: Tau-Charm Factory workshop, Stanford, CA (USA), 23-27 May 1989). Order Number DE90012878. Available from NTIS, PC A02/MF A01 - OSTI.

This paper discusses the design of the beam injection system for the tau-charm factory. Radiation shielding of the injection system is also discussed. (LSP)

37503 Numerical investigation of the plasma-grid interaction of the LBL HIF source. Hewett, D.W. (Lawrence Livermore National Lab., CA (USA)); Larson, D.J.; Rutkowski, H.L.; Humphries, S. pp. 126 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). DOE Contract W-7405-ENG-48. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

HIF ion sources may require ion arcs confined behind wire meshes in order to provide sufficient ion optical stability with acceptable ion thermal spread. The physics of the plasma-grid interaction and implications for its use as a source for HIF accelerators has been investigated numerically. The authors have studied these interactions with two models: a time-evolutionary electrostatic PIC code with an internal boundary configuration representing the grid wire(s) and a new method for finding time-independent configurations with flow. The PIC algorithm easily and correctly describes the evolutionary behavior of any reasonable sort of initial plasma configuration subject to the applied voltages n the grid and the external extraction surface on the accelerator side.

37504 Poisoning studies of an osmium-coated dispenser cathode. Nexsen, W.E. (Lawrence Livermore National Laboratory, Livermore, California 94551 (US)); Turner, W.C. *Journal of Applied Physics (USA)*, 68(1): 298-303 (1 Jul 1990).

The results of our studies on the reduction of the emission current from an osmium-alloy-coated dispenser cathode (derivative of the *M* cathode) due to exposure to various gases or vapors are reported. The primary interest of these studies is poisoning by chemical agents that might be encountered in the vacuum system of an induction linear accelerator. Of the constituents normally found in a tight unbaked vacuum chamber, the cathode is most sensitive to partial pressures of water vapor. Of the vapors studied which might be encountered in an induction accelerator, Freon was the most virulent poison.

4304 Storage Rings

Refer also to citation(s) 37436, 37442, 37775, 37944

37505 (DOE/SF/00515–T92) **Estimate of allowable beam current at 12 GeV.** Zisman, M.S. (Lawrence Berkeley Lab., CA (USA)). Stanford Linear Accelerator Center, Menlo Park, CA (USA). 27 May 1990. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515 ;AC03-76SF00098. (ABC–9). Order Number DE90012655. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

In designing a PEP-based B factory, one possibility that has been discussed is to operate for some experiments at a different energy asymmetry, say 2.5 GeV x 12 GeV. In this note we will examine the rf considerations that determine the maximum current that can be supported in the high-energy ring at 12 GeV. With the amount of installed rf power anticipated, the current limitations are significant. Achieving the same 1 cm rms bunch length specified at 9 GeV would require 44.5 MV, and would require the installation of additional rf cavities. 1 tab.

37506 (DOE/SF/00515–T93) **Seepage into PEP tunnel.** Weidner, H. Stanford Linear Accelerator Center, Menlo Park, CA (USA). 7 Jun 1990. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (ABC–10). Order Number DE90012656. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The current rate of seepage into the PEP tunnel in the vicinity of IR-10 is very low compared to previous years. Adequate means of handling this low flow are in place. It is not clear whether the reduction in the flow is temporary, perhaps due to three consecutive dry years, or permanent due to drainage of a perched water table. During PEP construction a large amount of effort was expended in attempts to seal the tunnel, with no immediate effect. The efforts to "manage" the water flow are deemed to be successful. By covering equipment to protect it from dripping water and channeling seepage into the drainage gutters, the seepage has been reduced to a tolerable nuisance. There is no sure, safe procedure for sealing a leaky shotcreted tunnel.

37507 (DOE/SF/00515–T94) **Parameters and requirements for the B Factory vacuum chamber.** Davies-White, W.A. Stanford Linear Accelerator Center, Menlo Park, CA (USA). 3 May 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (ABC–4). Order Number DE90012450. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The parameters that are required for the vacuum chamber of the B Factory High Energy Ring (HER) are presented here using the existing PEP chamber parameters for comparison. Each parameter will be discussed separately and the complete parameter sets for the two machines are collected together in the summary. 4 refs.

37508 (KEK–89-12, pp. 124-133) **Prospect of electron polarization at TRISTAN.** Yokoya, Kaoru (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Sep 1989. (CONF-8810498–: Workshop on the experiments by polarized proton and electron beams, Tsukuba (Japan), 27-28 Oct 1988). In *Proceedings of the workshop on the experiments by polarized proton and electron beams.* Order Number DE90777829. Available from NTIS (US Sales Only), PC A11/MF A01.

This note discusses the possible self-polarization of the electron/positron beam at TRISTAN for those who are interested in using polarized beams but not familiar with nor interested in the beam polarization theories. An estimation of the polarization level at TRISTAN is attempted by an extrapolation from the measurements at lower-energy machines such as SPEAR and PETRA where intensive studies have been done. (author).

37509 (RCNP-P–107, pp. 228-233) **The physics of Beam Circulation Rings and their future aspects.** Katayama, Ichiro (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics); Ando, Ainosuke; Hosono, Kazuhiko. Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

A beam circulation ring, capable of circulating 100 MeV proton beams for around thousand turns, is going to be installed in the West Experimental Hall in the new building. Although the ring has limited capacity in context to magnetic rigidity and acceptance, it could be stated that this is the first step to the future cooler synchrotron project. (author).

44 INSTRUMENTATION

Refer also to citation(s) 37409

4401 Radiation Instrumentation

Refer also to citation(s) 36801, 37280, 37497, 37698, 37751, 37753, 37773, 37774, 37836

37510 (BNL–44687) **The use of high-energy synchrotron radiation for x-ray scattering.** Hastings, J.B.; Siddons, D.P. Brookhaven National Lab., Upton, NY (USA). [1989]. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8910102–1: 2. European conference on progress in x-ray synchrotron radiation research, Rome (Italy), 2-6 Oct 1989). Order Number DE90012410. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

High-energy synchrotron radiation has the potential to open new areas of measurement which were previously unaccessible to x-ray scattering techniques. We present prototype measurements at both large and small momentum transfers to demonstrate the feasibility and benefits of the technique. 7 refs., 8 figs.

37511 (BONN-IR–89-54) **Calibration simulation. A calibration Monte-Carlo program for the OPAL jet chamber.** Biebel, O. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Dec 1989. 91p. (In German). Order Number DE90501237. Available from NTIS (US Sales Only), PC A05/MF A01.

A calibration Monte Carlo program has been developed as a tool to investigate the interdependence of track reconstruction and calibration constants. Three categories of calibration effects have been considered: The precise knowledge of sense wire positions, necessary to reconstruct the particle trajectories in the jet chamber. Included are the staggering and the sag of the sense wires as well as tilts and rotations of their support structures. The various contributions to the measured drift time, with special emphasis on the aberration due to the track angle and the presence of a transverse magnetic field. A very precise knowledge of the drift velocity and the Lorentz angle of the drift paths with respect to the drift field is also required. The effects degrading particle identification via energy loss dE/dx. Impurities of the gas mixture and saturation effects depending on the track angle as well as the influence of the pulse shaping-electronics have been studied. These effects have been parametrised with coefficients corresponding to the calibration constants required for track reconstruction. Excellent agreement with the input data has been achieved when determining calibration constants from Monte Carlo data generated with these parametrisations. (orig.).

37512 (CAPE–3017) **Gated microchannel plate detector (Engineering Materials).** Lawrence Livermore National Lab., CA (USA). [1989]. 22p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (UCRL–100587). Available from OSTI.

22 35-mm aperture cards.

This CAPE package contains the design drawings of a gating detector assembly to be used in NOVA diagnostic work. The drawings include microchannel plate mounts, vacuum flanges, cable feedthroughs, filmpad holders, mechanical feedthroughs, and various other components. A better explanation of the utility of this device should be gained through the author. (JEF)

37513 (CAPE–3018) **MODIX active detector (drawings AAA88-1104683-OA) [Engineering materials].** Lawrence Livermore National Lab., CA (USA). [1988]. 23p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Available from OSTI.

23 35-mm aperture cards.

These drawings reflect the completed version of a micro channel plate intensified x-ray detector used for x-ray imaging experiments. This particular device is used for one dimensional imaging experiments and has the advantage of a variable gain, dependant on the voltage applied to the micro channel plate and the phosphor. More that twenty five of these detectors have been built and found to be very reliable.

37514 (CAPE–3019) **VJACS detector assembly (HyJacs active detector), drawings AAA87-107748-OA [Engineering materials].** Lawrence Livermore National Lab., CA (USA). [1987]. 14p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Available from OSTI.

14 35-mm aperture cards.

These drawings reflect the completed version of a micro channel plate intensified x-ray detector used for imaging and spectroscopic experiments. This particular device is used for spectroscopic measurements and has the advantage of a variable gain, dependant on the voltage applied to the micro channel plate and the phosphor. More than ten of these detectors and they have been found to be very reliable.

37515 (CONF-890902–28) **The GAMMASPHERE.** Lee, I-Yang. Oak Ridge National Lab., TN (USA). [1989]. 28p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 198. American Chemical Society national meeting; Miami, FL (USA); 10-15 Sep 1989. Order Number DE90012734. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Arrays of Compton shielded Ge detectors, due to their high resolution, efficiency and low back ground, have become a powerful tool for gamma-ray spectroscopy. Many recent advances in high spin physics, such as the observation of superdeformed states, are the results of using these arrays. Presently, about ten such arrays are operational or near completion. These arrays typically have 20 detectors covering 10–15% of the total solid angle, and a total full energy efficiency of about 2%. Although they provide high efficiency for gamma-gamma two-fold coincidence experiments and moderate efficiency for three-fold coincidences, they are not adequate for higher fold coincidences. However, recent developments in high-spin γ-ray spectroscopy have demonstrated the needs for higher fold coincidence experiments. In the meantime, due to advances in detector and computer technology, it is technically possible to build detector arrays with much high efficiency and to acquire high-fold data at desired rates. The GAMMASPHERE is designed to carry out four- and five-fold coincidence experiment with high efficiency. The advantage of high-fold coincidence is the improvement of the resolving power, the ability to identify weak cascades from a large number of cascades. 10 refs., 11 figs., 1 tab.

37516 (CTH-RF–68) **Method of energy calibration of the TANSY neutron detectors.** Hoek, M.; Drozdowicz, K.; Aronsson, D. Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Reactor Physics. Mar 1990. 36p. Order Number DE90631442. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A method to calibrate an array of scintillation neutron detectors, using a γ source, is presented. The count rate is measured as a function of high voltage at a given discrimination level. The obtained distribution is differentiated and a maximum value is determined which corresponds to the voltage at which the gamma peak passes through the discrimination level. By repeating the measurement at different discrimination levels the experimental dependence between the discrimination level and the high voltage is found as a straight line in a log-log diagram. Two calibration parameter for each detector are determined from a fit of these straight lines. A recalculation from the energy of the used γ source to any other energy is then possible and the obtained relation can be used to calculate discrimination levels and high voltages for each detector. Verification procedures are described. (authors).

37517 (EGG–10617-2064) **Improved yield of high resolution mercuric iodide gamma-ray spectrometers.** Gerrish, V.; van den Berg, L. EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations. [1990]. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-88NV10617. (CONF-900563–11: 7. symposium on radiation measurements and applications, Ann Arbor, MI (USA), 21-24 May 1990). Order Number DE90012580. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Mercuric iodide (HgI_2) exhibits properties which make it attractive for use as a solid state nuclear radiation detector. The wide bandgap (E_g = 2.1 eV) and low dark current allow room temperature operation, while the high atomic number provides a large gamma-ray cross section. However, poor hole transport has been a major limitation in the routine fabrication of high-resolution spectrometers using this material. This paper presents the results of gamma-ray response and charge transport parameter measurements conducted during the past year at EG&G/EM on 96 HgI_2 spectrometers. The gamma-ray response measurements reveal that detector quality is correlated with the starting material used in the crystal growth. In particular, an increased yield of high-resolution spectrometers was obtained from HgI_2 which was synthesized by precipitation from an aqueous solution, as opposed to using material from commercial vendors. Data are also presented which suggest that better spectrometer performance is tied to improved hole transport. Finally, some initial results on a study of detector uniformity reveal spatial variations which may explain why the correlation between hole transport parameters and spectrometer performance is sometimes violated. 6 refs., 3 figs.

37518 (EGG-M–89502) **A Recoil Mass Spectrometer for the HHIRF [Holifield Heavy Ion Research Facility] facility.** Cole, J.D. (EG and G Idaho, Inc., Idaho Falls, ID (USA)); Cormier, T.M.; Hamilton, J.H. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1989]. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC07-76ID01570 ;FG05-88ER40407 ;FG05-86ER40256. (CONF-891044–11: 1. international conference on radioactive nuclear beams, Berkeley, CA (USA), 16-18 Oct 1989). Order Number DE90013087. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A Recoil Mass Spectrometer (RMS) is to be built that will carry out a broad research program in heavy-ion physics. The RMS will make possible the study of otherwise inaccessible exotic nuclei. Careful attention has been given to match the RMS to all the beams available from the HHIRF accelerators, including those beams with the highest energy as well as massive particles for use in inverse reactions. With the use of inverse reactions, the production of secondary radioactive beams is possible. This is due to the design of the spectrometer. The RMS is to be a momentum achromat followed by a split electric dipole mass spectrometer of the type operating at NSRL at the University of Rochester. The RMS is essential for many of the proposed experiments on short lived and/or low cross section products. 18 refs.

37519 (FNAL/C–90/46) **Recent developments in high-speed, non-sampling electromagnetic calorimetry.** Anderson, D.F.; Ramberg, E.J. Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1990. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-9003150–6: 5. international conference on instrumentation for colliding beam physics, Novosibirsk (USSR), 15-21 Mar 1990). Order Number DE90013003. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Brief discussions are given of the work that has been done on the suppression of the slow component in BaF_2, the developments in the understanding of undoped CsI, and the properties of the new scintillator CeF_3. The properties of the Cherenkov radiator PbF_2 along with test beam results are presented. Monte Carlo simulations indicate that, with the addition of a small amount of scintillator, PbF_2, can be made hadron compensating off-line so that the resolution of a compensating hadron calorimeter will not be degraded by its presence. 14 refs., 6 figs., 4 tabs.

37520 (FNAL/C–90/110) **SDC at high luminosity.** Green, D. Fermi National Accelerator Lab., Batavia, IL (USA). May 1990. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-9004213–1: International conference on solenoidal detectors for the SSC, Tsukuba (Japan), 23-25 Apr 1990). Order Number DE90012669. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Why is it prudent to plan for a luminosity (L) of $>10^{34}/(cm^2 sec)$ from the beginning? First, the SSC is easily capable of attaining high luminosity. In comparison, for $\bar{p}p$ machines such as the Tevatron, increases in L are difficult. Second, after early runs at design luminosity, the only simple upgrade to a general purpose detector is an increase in luminosity. Third, and most important, the only known model independent physics goal of SSC is in the electroweak sector; the ZZ scattering amplitude reaches the unitarity bound for $\sqrt{\hat{s}} \simeq 3$ TeV. In order to reach this mass range, and assure that some new physics is found, high luminosity running is

needed. Since high luminosity running is desirable and easily attainable, it is inevitable. Therefore, one should build the "hooks" for upgrades to high L into the SDC from the beginning. The experience of CDF is that if this is not done, upgrades can be painful. Specifically, if possible, SDC should make sure that the chosen technologies allow high L operation. The time to plan for the whole useful lifetime of SDC is from the beginning. 9 refs., 6 figs.

37521 (IS-T–1468) **Mechanism and applicability of hydrolysis of peptides and proteins utilizing Pt(II) complexes.** Burgeson, I.E. Ames Lab., IA (USA). 13 Jun 1990. 105p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90012448. Available from NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

The hydrolysis of amino acid esters and amides has been achieved by using organic reagents, strongly acidic and basic solutions, and transition metal complexes. However, enzymes have always been able to surpass these methods in terms of speed of the hydrolysis and the mild conditions necessary to observe hydrolysis. In order to understand how enzymes undergo their reactions with such remarkable speed and efficiency, researchers are studying and developing inorganic reagents which can facilitate the hydrolysis of peptide bonds. The treatment of the tripetide γ-glutamyl-cyteinylglycine with one equivalent of $PtCl_4^{-2}$ results in hydrolysis of the cysteinyl-glycine bond. The reaction is strongly dependent on the amount of chloride ion in solution and also shows a lesser dependence on ionic strength and pH. Hydrolysis is promoted through a chelate interaction of the platinum with the sulfur of cysteine and the carbonyl oxygen of the amide bond. The hydrolysis of proteins was then undertaken. Yeast cytochrome c and the subunits of hemoglobin were examined to determine if $PtCl_4^{-2}$ or $Pt(en)Cl_2$ could promote cleavage of the peptide bond next to a cysteine residue. It appears that hydrolysis of the peptide bond to the right of the cysteinly side chain has been realized. 51 refs., 12 figs., 12 tabs.

37522 (KEK–89-13, pp. 25-32) **Neutron reflectometer.** Kawabata, Yuji (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1989. (In Japanese). (CONF-8903201–: 2. KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons, Tsukuba (Japan), 11 Mar 1989). In *The 2nd KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons.* Order Number DE90760025. Available from NTIS (US Sales Only), PC A07/MF A01.

The surface physics research using thermal neutrons or cold neutrons has been carried out so far, but the weak signals were always the problem. In the field of ultracold neutrons, the existence of hydrogen on metallic mirror surfaces brings about the shortening of the confinement life of ultracold neutrons in neutron bottles, therefore surface phenomena are the problem. By confining ultracold neutrons in the bottle made of the material which is the object of surface research, there is the possibility to carry out precision surface physics experiment. In this report, on the research of surface physics and chemistry, the experimental apparatuses utilizing the total reflection of thermal neutrons and cold neutrons and a part of the fields of research are introduced. Neutron reflectometers are those for knowing the potential structure of sample surfaces to neutrons by making the total reflection of the neutrons on the mirror surfaces of the samples. By measuring the kappa dependence of neutron reflectivity, the information on atomic configuration and magnetic structure in the direction of normal to sample surfaces can be obtained. The examples of neutron reflectometers are shown. The examples of the experimental results are reported. (K.I.).

37523 (KEK–89-13, pp. 33-43) **Multi-layer film neutron interferometers.** Ebisawa, Tooru (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1989. (In Japanese). (CONF-8903201–: 2. KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons, Tsukuba (Japan), 11 Mar 1989). In *The 2nd KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons.* Order Number DE90760025. Available from NTIS (US Sales Only), PC A07/MF A01.

Since the first success by H. Rauch et al. using a silicon complete crystal, neutron interferometers have been utilized for the research on the basic physics of neutrons and the precision measurement of neutron refractive index, and the spectacular results have been obtained. Also for the verification on neutron waves of Berry phase, it is expected to become a powerful weapon. However in the interferometers of silicon single crystals, the applicable neutron wavelength is limited to below 6A, and there are the problems of dimensional restraint and others. Recently in USSR, by utilizing the diffraction grating arranged regularly on a glass surface, the interferometer which can be applied to long wavelength neutrons was successfully developed. The authors have developed various multi-layer film neutron mirrors which utilize the Bragg's reflection, and can make the mirrors with arbitrary reflectivity. The multi-layer film neutron interferometers are those of Mach-Zehnder type similar to silicon interferometers, and are composed of a half mirror as the beam splitter, two reflection mirrors and a half mirror for phase analysis. For the purpose of verifying that multi-layer film neutron interferometers can be manufactured, the authors developed that with neutron wavelength of 22A using Ni-Ti multi-layer film. Its principle, the problems in the manufacture, the features and the application to physical experimental are reported. (K.I.).

37524 (KEK–89-17, pp. 120-124) **Detectors for the asymmetric B factory.** Tadao, Nozaki (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Nov 1989. (In Japanese). (CONF-8910393–: Workshop for asymmetric B-factory at KEK, Tsukuba (Japan), 2-4 Oct 1989). In *Proceedings of the workshop on asymmetric B factory at KEK.* Order Number DE90777869. Available from NTIS (US Sales Only), PC A12/MF A01.

Published in summary form only. POSITION SENSITIVE DETECTORS/b mesons; MESON FACTORIES; SI SEMICONDUCTOR DETECTORS; SPATIAL RESOLUTION; LINEAR MOMENTUM; PARTICLE IDENTIFICATION

37525 (KEK–89-17, pp. 125-141) **Silicon vertex detector.** Tajima, H. (Nagoya Univ. (Japan). Dept. of Physics); Niwa, K.; Nakamura, M. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Nov 1989. (CONF-8910393–: Workshop for asymmetric B-factory at KEK, Tsukuba (Japan), 2-4 Oct 1989). In *Proceedings of the workshop on asymmetric B factory at KEK.* Order Number DE90777869. Available from NTIS (US Sales Only), PC A12/MF A01.

A possible performance of a silicon vertex detector in the asymmetric e^+e^- collider experiments for a B-meson factory is discussed. Also current status and future subjects of development for micro vertex system is reported. (author).

37526 (LA-UR–90-1784) **Low-mass, high-rate cylindrical MWPC's for the MEGA experiment.** Mischke, R.E.; Armijo, V.; Black, J.K.; Bolton, R.D.; Carius, S.; Cooper, M.D.; Espinoza, C.; Hart, G.W.; Hogan, G.E.; Piilonen, L.E. Los Alamos National Lab., NM (USA). [1990]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-900822–2: 25. IUPAP international conference on high energy physics, Singapore (Singapore), 2-8 Aug 1990). Order Number DE90012057. Available from NTIS, PC A02/MF A01; OSTI; INIS.

The construction of MWPCs for the MEGA experiment at LAMPF are described. The chambers are cylindrical, low mass (3×10^{-4} radiation lengths), and are designed to operate at high rates (3×10^4 /mm^2/s). Several novel construction techniques have been developed and custom electronics have been designed to help achieve the required performance, which corresponds to that needed at high luminosity colliders. 4 refs., 3 figs.

37527 (LPNHEP–89-05) **Data acquisition system realization for H1 experiment.** Del Buono, L. Paris-6 Univ., 75 (France). Lab. de Physique Nucleaire et de Hautes Energies; Paris-7 Univ., 75 (France). Jun 1989. 169p. (In French). Order Number DE90500780. Available from NTIS (US Sales Only), PC A08/MF A01.

The acquisition and trigger system for H1 liquid argon calorimeter deals with severe constraints which have to be taken into account. We describe the system which results from these constraints, emphasizing the solutions adopted to meet the specificities of the detector and the difficult experimental conditions at HERA:

high physical background (10^{4-5} Hz), physics and background events pile up (10%), large crossing frequency of proton and electron bunches (10.4 MHz). Next, we present a detailed description of the acquisition and online control scheme used during the calorimetry tests in SPS beam, at CERN. This test system, prefiguring the final one (which will start to work at the end of 1989), includes a fast frontal processor CAB (taking charge of the electronics read out and sequencing, and furthermore producing simple histograms). The CAB is controlled by a Micro Vax computer which realizes the user interface, allowing a quick visualisation and verification of the acquired data, these functions being performed in multitasking environment.

37528 (NAC-AR–88-01, pp. 120-133) **Research and calibration projects: Dosimetry intercomparisons.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988*. Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

The NAC (National Accelerator Centre), South Africa, has been involved in neutron dosimetry intercomparison studies at the Universite Catholique de Louvain, Belgium (UCL), and at the MRC Cyclotron Unit, Clatterbridge Hospital, U.K. A reciprocal visit was paid to the NAC by UCL personnel in order to undertake both dosimetry and radiobiological intercomparison studies. Only the physical dosimetry intercomparison measurements undertaken with tissue equivalent ionization chambers have been analysed. Measurements were also made with Geiger-Mueller counters in order to derive the gamma dose component in the neutron beam, but analyses are not yet complete. 6 figs., 19 refs., 5 tabs.

37529 (NAC-RR–667) **A national photon dosimetry intercomparison.** Jones, D.T.L. (National Accelerator Centre, Faure (South Africa)); Yudelev, M. National Accelerator Centre, Faure (South Africa). Jul 1989. 26p. Available from the National Accelerator Centre, Council for Scientific and Industrial Research, P.O. Box 72, Faure, 7131, South Africa.

Randomized clinical trials involving neutron therapy at the National Accelerator Centre (NAC) and photon therapy at various radiotherapy centres througout South Africa are due to commence during 1989. As a precursor to these trials a photon dosimetry intercomparison study has been undertaken at all participating photon therapy centres. These measurements are essential in order to establish the range of differences between the doses determined under the same irradiation conditions at the different centres, using measurements made by NAC personnel as the standard. The results show a total spread in doses determined at the participating hospitals to be about 8%. It is recommended that all hospitals immediately implement the American Association of Physicists in Medicine (AAPM) dosimetry protocol and that some attention be given to improving dosimetry practices in order to establish a uniform system and reduce the dose discrepancies. With the aim of promoting and facilitating the use of the AAPM protocol detailed tabulations and formulae are provided. 1 fig., 20 refs., 7 tabs.

37530 (ORNL/TM–11557) **Two-dimensional position-sensitive detectors for small-angle neutron scattering.** McElhaney, S.A.; Vandermolen, R.I. Oak Ridge National Lab., TN (USA). May 1990. 128p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90011285. Available from NTIS, PC A07/MF A01; OSTI; INIS; GPO Dep.

In this paper, various detectors available for small angle neutron scattering (SANS) are discussed, along with some current developments being actively pursued. A section has been included to outline the various methodologies of position encoding/decoding with discussions on trends and limitations. Computer software/hardware vary greatly from institute and experiment and only a general discussion is given to this area. 85 refs., 33 figs.

37531 (RCNP-P–107, pp. 93-99) **In-beam gamma-ray spectroscopy with crystal ball.** Furuno, Kohei (Tsukuba Univ., Ibaraki (Japan). Inst. of Physics). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'*. Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

Recent developments of high-resolution crystal balls for nuclear structure studies have been discussed. Experiments on high-spin states or nuclear reaction mechanisms with a crystal ball and the upgraded cyclotron at RCNP are proposed. (author).

37532 (RCNP-P–107, pp. 214-218) **High resolution magnetic spectrograph 'Grand Raiden'.** Yosoi, M. (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics); Fujiwara, M.; Morinobu, S.; Ikegami, H. Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'*. Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

In the report of the last 1988, the basic design of a new high resolution ($p/\Delta p$ = 37750) magnetic spectrograph of the type QSQDMD (+D), named 'Grand Raiden', was presented. Here, we show results of more detailed ray-tracing calculations; the focal line property, the image aberration, and the compensation of the kinematic broadening by multipole fields. The final design of the new DSR (dipole for spin rotation) for the measurement of in-plane spin observables are also reported. (author).

37533 (SLAC-PUB–5212) **Progress report on the use of hybrid silicon pin diode arrays in high energy physics.** Shapiro, S.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)); Jernigan, J.G.; Arens, J.F. Stanford Linear Accelerator Center, Menlo Park, CA (USA). May 1990. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. Order Number DE90011252. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We report on the successful effort to develop hybrid PIN diode arrays and to demonstrate their potential as components of vertex detectors. Hybrid pixel arrays have been fabricated by the Hughes Aircraft Co. by bump-bonding readout chips developed by Hughes to an array of PIN diodes manufactured by Micron Semiconductor Inc. These hybrid pixel arrays were constructed in two configurations. One array format has 10 x 64 pixels, each 120 μm square; and the other format has 256 x 156 pixels, each 30 μm square. In both cases, the thickness of the PIN diode layer is 300 μm. Measurements of detector performance show that excellent position resolution can be achieved by interpolation. By determining the centroid of the charge cloud which spreads charge into a number of neighboring pixels, a spatial resolution of a few microns has been attained. The noise has been measured to be about 300 electrons (rms) at room temperature, as expected from KTC and dark current considerations, yielding a signal-to-noise ratio of about 100 for minimum ionizing particles. 4 refs., 17 figs.

37534 (SLAC-PUB–5224) **The silicon strip detector at the Mark 2.** Jacobsen, R. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)); Golubev, V.; Lueth, V.; Barnett, B.; Dauncey, P.; Matthews, J.; Adolphsen, C.; Burchat, P.; Gratta, G.; King, M. Stanford Research Inst., Menlo Park, CA (USA). Apr 1990. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-9003150–4: 5. international conference on instrumentation for colliding beam physics, Novosibirsk (USSR), 15-21 Mar 1990). Order Number DE90011800. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

We have installed a Silicon Strip Vertex Detector in the Mark II detector at the Stanford Linear Collider. We report on the performance of the detector during a recent test run, including backgrounds, stability and charged particle tracking. 10 refs., 9 figs.

37535 (SSC–229) **Radiation levels in SSC [Superconducting Super Collider] calorimetry.** Groom, D.E. Lawrence Berkeley Lab., CA (USA). SSC Central Design Group. Jul 1990. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-89ER40486. (CONF-890379–19: Workshop on calorimetry for the SSC, Tuscaloosa, AL (USA), 13-17 Mar 1989). Order Number DE90013016. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Estimates of ionizing dose and neutron fluence have been made for typical SSC detector configurations exposed to radiation from p-p collisions. Using a description of "average events" in conjunction with simulations of secondary processes, it is found that in most cases the ionizing dose (D) or neutron fluence (ϕ) can adequately be expressed as D (or ϕ) = [A/][r^{2}sin $^{\alpha+2}$ θ]. Here A depends on the process and exposure time, and α is slightly less than unity. For calorimetry r is the distance from the interaction point. Under nominal conditions a calorimeter element 2 m from interaction point and 6° from the beam line is subjected to an annual dose is 0.1 MGy at electromagnetic shower maximum and an annual neutron fluence of 10^{14} cm^{-2} at hadronic cascade maximum. A detector at an 8 TeV x TeV p-p collider with the same "physics reach" would experience about 27 times as much radiation. 21 refs., 7 figs., 2 tabs.

4402 Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to citation(s) 36759, 37304

4404 Well Logging Instrumentation

Refer also to citation(s) 36743

37536 (SAND–90-0661C) **Development and field testing of the high-temperature borehole televiewer.** Duda, L.E.; Uhl, J.E.; Wemple, R.P. Sandia National Labs., Albuquerque, NM (USA). [1990]. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900823–9: Annual meeting of the Geothermal Resources Council and international symposium on geothermal energy, Kailua Kona, HI (USA), 20-24 Aug 1990). Order Number DE90009348. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The High-Temperature Borehole Televiewer is a downhole instrument which provides acoustic pictures of the borehole walls that are suitable for casing inspection and fracture detection in geothermal wells. The Geothermal Drilling Organization has funded the development of a commercial tool survivable to temperatures up to 275°C and pressures of 5000 psi. A real-time display on an IBM-compatible PC was included as part of the developmental effort. This paper describes the three principal components are: the mechanical section, the electronics, and the computer software and hardware. Each of these three components are described with special attention to important design changes most pertinent to a high temperature environment. The results of two field tests of the televiewer system are also described. 7 refs., 4 figs.

4406 Optical Instrumentation

Refer also to citation(s) 36829, 36949, 37244, 37298, 37371, 37372, 37384

37537 (BNL–44686) **Instrumental effects in surface finish measurement.** Church, E.L. (Army Research and Development Command, Dover, NJ (USA)); Takacs, P.Z. Brookhaven National Lab., Upton, NY (USA). [1988]. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8809123–4: International congress on optical science and engineering, Hamburg (Germany, F.R.), 13-23 Sep 1988). Order Number DE90012411. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The derivation of surface-finish statistics from profile measurements are reviewed with emphasis on the corrections and limitations imposed by the measurement process itself. These issues are important for the comparison of the results of different types of measurements, connecting, results with functional surface properties, and evaluating different finishing techniques. 15 refs., 3 figs.

37538 (CONF-900756–7) **Time resolved techniques: An overview.** Larson, B.C.; Tischler, J.Z. Oak Ridge National Lab., TN (USA). Jun 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From SPIE's international symposium on optical and optoelectronic applied science and engineering and exhibit; San Diego, CA (USA); 8-13 Jul 1990. Order Number DE90012733. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Synchrotron sources provide exceptional opportunities for carrying out time-resolved x-ray diffraction investigations. The high intensity, high angular resolution, and continuously tunable energy spectrum of synchrotron x-ray beams lend themselves directly to carrying out sophisticated time-resolved x-ray scattering measurements on a wide range of materials and phenomena. When these attributes are coupled with the pulsed time-structure of synchrotron sources, entirely new time-resolved scattering possibilities are opened. Synchrotron beams typically consist of sub-nanosecond pulses of x-rays separated in time by a few tens of nanoseconds to a few hundred nanoseconds so that these beams appear as continuous x-ray sources for investigations of phenomena on time scales ranging from hours down to microseconds. Studies requiring time-resolution ranging from microseconds to fractions of a nanosecond can be carried out in a triggering mode by stimulating the phenomena under investigation in coincidence with the x-ray pulses. Time resolution on the picosecond scale can, in principle, be achieved through the use of streak camera techniques in which the time structure of the individual x-ray pulses are viewed as quasi-continuous sources with ~100–200 picoseconds duration. Techniques for carrying out time-resolved scattering measurements on time scales varying from picoseconds to kiloseconds at present and proposed synchrotron sources are discussed and examples of time-resolved studies are cited. 17 refs., 8 figs.

37539 (ORNL/TM–11380) **Workshop on scientific and industrial applications of free electron lasers.** Difilippo, F.C. (Oak Ridge National Lab., TN (USA)); Perez, R.B. Oak Ridge National Lab., TN (USA). May 1990. 48p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012038. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A Workshop on Scientific and Industrial Applications of Free Electron Lasers was organized to address potential uses of a Free Electron Laser in the infrared wavelength region. A total of 13 speakers from national laboratories, universities, and the industry gave seminars to an average audience of 30 persons during June 12 and 13, 1989. The areas covered were: Free Electron Laser Technology, Chemistry and Surface Science, Atomic and Molecular Physics, Condensed Matter, and Biomedical Applications, Optical Damage, and Optoelectronics.

37540 Soliton switch using birefringent optical fibers. Chen, C. (Department of Electrical Engineering, University of Maryland, Baltimore, Maryland 21228 (USA)); Wai, P.K.A.; Menyuk, C. *Optics Letters (USA),* 15(9): 477-479 (1 May 1990).

The use of solitons is proposed for interferometric switching in birefringent optical fibers. Pulse propagation in the fiber is modeled by the coupled nonlinear Schroedinger equation, in which the ratio between the self-coupling and cross-coupling terms depends on the ellipticity of the fiber eigenmodes. It is shown that shadows occur unless the self-coupling and the cross-coupling are equal and that these shadows seriously affect the contrast ratio attainable by a switch. These two couplings become equal at an ellipticity angle $\theta \approx 35°$, and, within a tolerance of $\theta = \pm 5°$, a contrast ratio of 10 or more can be achieved.

37541 Observation of molecular vibrations in the time domain with incoherent laser pulses. Huang, Z.Q. (Department of Electrical Engineering, Bonner Hall, State University of New York at Buffalo, Amherst, New York 14260 (USA)); Xie, Y.J.; Huang, G.L.; Kwok, H. *Optics Letters (USA),* 15(9): 501-503 (1 May 1990). DOE Contract FG02-85ER13405.

With the method of self-diffraction of incoherent light, molecular vibrations were observed in real time in various dye molecules pumped near the absorption edge. In Rhodamine 560, 35-fsec oscillations in the signal were measured, which corresponds to a vibrational frequency of 1000 cm^{-1}. Simultaneously, this technique can be used to deduce the ultrafast dephasing times in the molecular vibrational quasi-continuum. Dephasing times of 20 and 150 fsec were observed in Rhodamine 590 and Rhodamine 560, respectively.

37542 Gain and noise characteristics of a Brillouin amplifier and their dependence on the spatial structure of the pump beam. Scott, A.M. (Royal Signals and Radar Establishment, Malvern, Worcestershire WR14 3PS, UK (GB)); Watkins, D.; Tapster, P. *Journal of the Optical Society of America, Part B: Optical Physics (USA)*, 7(6): 929-935 (Jun 1990).

Amplification of a weak input signl (~0.5 pJ) in a high-gain ($G=10^9$) Brillouin amplifier has resulted in an ouput signal-to-noise ratio 85:1, within a factor of 4 of the theoretical estimate. For a near-diffraction-limited Gaussian pump beam this noise increases exponentially with pump intensity with the same gain coefficients as for an input signal. When the pump beam is aberrated, the effective gain coefficient for the conjugate is enhanced by as much as a factor of 3, depending on the nature of the aberration. The enhancement factor *J* is found to vary significantly when the laser beam passes through different regions of the aberrator.

37543 X-ray spectromicroscopy with a zone plate generated microprobe. Ade, H. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794 (USA)); Kirz, J.; Hulbert, S.L.; Johnson, E.D.; Anderson, E.; Kern, D. *Applied Physics Letters (USA)*, 56(19): 1841-1843 (7 May 1990).

The scanning photoelectron microscope at the National Synchrotron Light Source (NSLS) has recently recorded micrographs with a resolution below half a micron. To demonstrate elemental and chemical sensitivity at the submicron level, an artificial structure consisting of Al and SiO_2 lines on a boron-doped silicon substrate was examined. Al 2*p* and Si 2*p* primary photoelectrons as well as O *KVV* Auger electrons were used for image formation. Contrast reversal between the the Si and SiO_2 areas was observed in images formed from Si 2*p* and oxide-shifted Si 2*p* photoelectrons. The soft x-ray undulator at the NSLS provides coherent illumination of a zone plate to produce the microprobe. The sample is mechanically scanned through the beam allowing the formation of images from photoelectrons detected by a single-pass cylindrical mirror analyzer, or a more complete spectroscopic examination of a selected area of the sample.

37544 X-ray streak camera with 2 ps response. Murnane, M.M. (Department of Physics, University of California at Berkeley, Berkeley, California 94720 (USA)); Kapteyn, H.C.; Falcone, R.W. *Applied Physics Letters (USA)*, 56(20): 1948-1950 (14 May 1990). DOE Contract W-7405-ENG-48.

We have developed an x-ray streak camera system with a temporal response of 2 ps (full width at half maximum). The response of the camera was measured using soft x rays in the 30 eV to 1 keV energy range which were emitted from a plasma created by a high-intensity, subpicosecond laser pulse. A single shot, resolution-limited, relative timing precision of 0.2 ps was demonstrated for x-ray emission events.

4408 Miscellaneous Instrumentation

Refer also to citation(s) 36712, 37281, 37423, 37543, 38271

45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

Refer also to citation(s) 36795

37545 (CONF-9006206–1) **Recent advances in analytic combat simulation: From modeling to validation and beyond.** Protopopescu, V.; Santoro, R.T.; Azmy, Y.Y. Oak Ridge National Lab., TN (USA). [1990]. 19p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. From 28. Military Operations Research Society (MORS) symposium; Annapolis, MD (USA); 12-14 Jun 1990. Order Number DE90012786. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A new analytic approach is presented that models acute or subdued conflict situations (ranging from fierce combat to peaceful competition) by using nonlinear partial differential equations. One- and two-dimensional applications to conventional warfare are reported which replicate successfully both attrition and maneuver. The comparison between the analytic model and a wargame exercise yields excellent agreement and provides a strong validation basis for further developments and applications. 19 refs., 6 figs.

37546 (K/DSRD–115) **Historical validation of an attrition model.** Hartley, D.S. III. Oak Ridge Gaseous Diffusion Plant, TN (USA). May 1990. 51p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OT21400. Order Number DE90012420. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This paper is the third in a series of reports on the breakthrough research in historical validation of attrition in conflict. Significant defense policy decisions, including weapons acquisition and arms reduction, are based, in part, on models of conflict. Most of these models are driven by their attrition algorithms, usually forms of the Lanchester square and linear laws. None of these algorithms have been validated. Helmbold demonstrated a relationship between the Helmbold ratio, a ratio containing initial force sizes and causalities, and the initial force ratio in a large number of historical battles. It has also been shown that at least two models of warfare could produce these results, a mixed linear-logarithmic Lanchestrain attrition law and a constraint (of battle engagement and termination) model of attrition. This paper examines the distribution statistics of the historical data and determines that the mixed law model is favored. The differential form of the mixed law model that best fits the casualty data is found. This model also provides a parameter to predict the victor. 6 refs., 28 figs., 13 tabs.

37547 (ORNL/CSD/TM–269) **Scheduling Algorithm for Improving Lift (SAIL): Documentation for initial operating capability.** Hawthorne, J.E.; McLaren, R.A. Oak Ridge National Lab., TN (USA). Apr 1990. 190p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE90011299. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

The Military Sealift Command, a component of the United States Transportation Command, is responsible for the sealift of military personnel and material during a crisis. Conceptual plans for these complex moves, called deliberate plans, are continually being prepared. A computer-based scheduling system, the Sealift Strategic Analysis Subsystem (SEASTRAT), is under development for assisting in the production of these plans. The ship scheduling portion of this system, the Scheduling Algorithm for Improving Lift (SAIL), combines linear optimization and heuristic methods to determine ship routes and cargo loadings which honor a variety of complex operational constraints.

37548 (ORNL/TM–11274) **Arsenal of democracy in the face of change: Issues underlying the implementation of industrial mobilization policy: Working paper No. 3.** Brinkerhoff, J.R. (Brinkerhoff Associates, Burke, VA (USA)). Oak Ridge National Lab., TN (USA). May 1990. 44p. Sponsored by U.S. Federal Emergency Management Agency. DOE Contract AC05-84OR21400. Order Number DE90012036. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper reviews the background and current status of industrial preparedness in the United States and analyzes ways to implement new policy procedures. What will it take to assure that the United States can be mobilize its industry rapidly to support a major conventional war? The report reaches nine important conclusions: (1) Mobilization and industrial preparedness policy must be linked and integrated with other aspects of national security policy and the national military strategy. (2) The United States cannot reverse the flow of time and go back to a period of industrial superiority and self-sufficiency. (3) The United States must come to grips with its responsibilities for providing war materiel for Allies. (4) Similarly, the United States must recognize the interdependency of international trade and industrial production. (5) Graduated Mobilization Response needs to be adopted by the government and DOD and integrated into industrial preparedness policy. (6) The DOD industrial surge program should be fully funded. (7) Industrial preparedness planning should be funded now on a priority basis. (8) Organizational responsibilities and relationships for industrial preparedness have to be clarified, strengthened, and supported. (9) Finally, it is necessary to pay attention to this problem now. The report concludes by suggesting that the United States must develop a unified, clear statement of preparedness

policy, linked with other security/military policies and strategies. This must be accomplished with some swiftness, and with the cognizance of current (and most likely to continue) domestic an international economic interdependencies.

4501 Chemical Explosions and Explosives

Refer also to citation(s) 37198, 38347

37549 (ALS/TR–90-006) **Hypervelocity explosive launchers.** Pujols, H.C. (CEA, 75 - Paris (France)). Sandia National Labs., Albuquerque, NM (USA). 20 Mar 1990. 17p. Translated from presentation prepared for the 40th meeting of the Aeroballistic Range Association, September 25-28, 1989, Paris. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909229–3: Aeroballistic Range Association meeting, Paris (France), 24-28 Sep 1989). Order Number DE90011713. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This publication describes a number of hypervelocity launchers which use plane waves initiated by cylindrical charges of high explosive. Peak projectile velocities achievable with a single thruster stage range up to 7000 m/sec. Higher peak projectile velocities have been achieved with multistage launchers. Theoretically, projectile velocities are limited only by the maximum usable explosive mass of the first stage. 8 figs.

37550 (LA–11789-MS) **High explosives skid impact initiation study.** Vigil, A.S.; Bunch, J.M.; Jaeger, D.L.; Smith, P.D.; Abeyta, E.E. Los Alamos National Lab., NM (USA). Jun 1990. 22p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE90011266. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this study was to develop a better quantitative understanding of explosive behavior under skid impact conditions. We evaluated the effects of sample weight, impact velocity, contact surface area at impact, target surface roughness, and target material on the skid impact HE ignition threshold. We also quantified the effects of two parameters that had never been fully investigated in the standard skid impact sensitivity test: explosive sample size and angle of incidence. These parameters were studied experimentally by conducting a series of tests, and analytical, with a number of one-, two-, and three-dimensional computer models. This study is the first phase in a program to measure the transient heat produced in the ignition of a high explosive sample as it impacts an infrared (IR) transmissive target. We will use the experimentally derived data to enhance our ability to predict the onset of ignition in impact-heated high explosives. 12 refs., 9 figs., 2 tabs.

37551 (LA–11835-MS) **Two-dimensional multiburst calculations with the SHALE code.** DeVault, G.P.; Trent, B.C. Los Alamos National Lab., NM (USA). Jul 1990. 36p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE90012912. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The effects of timing and separation of two equal explosions are discussed as a result of numerical calculations in a homogeneous, saturated, infinite material. Two-dimensional, two-source calculations were performed with the SHALE code and compared to results assuming the linear superposition of two single explosions. An analytic analysis is presented that shows how the region of enhancement varies with separation distance and timing delay. 1 ref., 23 figs.

37552 (ORNL/FTR–2810) **[Packaging regulations for chemical explosives]: Foreign trip report, January 26, 1988–February 1, 1988.** Pal, B.C. Oak Ridge National Lab., TN (USA). 17 Feb 1988. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE90012349. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of the trip was to visit Nobel Chemicals in Sweden and to confer with the Department of Transportation personnel in Sweden and in England on the technical and regulatory problems in the bulk shipping of the high explosives RDX and HMX. It is customary in the United States (US) to add isopropyl alcohol to the bulk shipment of water-wet high explosives RDX and HMX. The explosives are packed in cloth bags which are placed in plastic-lined fiber drums. The addition of alcohol presumably prevents mildewing of cloth bags and freezing of the wet explosives in cold weather. In Europe, however, these explosives are shipped in polyethylene-lined fiber drums with not less than 15% water only, even in cold weather. Water-wet frozen explosives have not proved to be any more sensitive than its unfrozen counterpart and no mildew problem has been encountered. It looks promising that the US Department of Transportation regulations can be changed to permit the bulk shipment of these explosives in water only without the addition of isopropyl alcohol. This is expected to cut down the packaging cost considerably. In addition, the packaging procedure in the US can be modernized by introducing more mechanical and efficient handling as seen at Nobel Chemicals. 2 figs.

37553 (UCRL-JC–103107-Rev.1) **Generic initiation train for the fuzing: Revision 1.** Lee, R.S.; Weingart, R.C.; Berg, J.D. Lawrence Livermore National Lab., CA (USA). Mar 1990. 15p. Sponsored by U.S. Department of Defense; U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9003142–1-Rev.1: 1990 joint government/industry symposium on insensitive munitions technology, White Oak, MD (USA), 13-14 Mar 1990). Order Number DE90012467. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The insensitive munitions now under development in the Department of Defense (DOD) complex will require fuses which do not compromise the safety afforded by the use of insensitive main charge explosives (IHEs). At the same time the fuses must provide a stimulus which is robust enough to override the higher shock initiation threshold and the probably-larger critical diameter and corner-turning distance of the IHE. Design of the initiation train is critical to the safety of an IHE fuse in abnormal environments and to its proper functioning for initiating the IHE. It would be particularly useful to develop design criteria for an initiation train which could be used generally in IHE munitions. The goal of our study was to demonstrate the feasibility of designing an initiation train which does not compromise the safety of an IHE main charge in abnormal thermal environments, i.e., fast and slow heating tests. 1 ref., 13 figs.

4502 Nuclear Explosions and Explosives

Refer also to citation(s) 37557

4505 Strategic Defense Initiative

Refer also to citation(s) 36925, 36929, 36930, 36931, 37431

37554 (DOE/DP/50066–T6) **Department of Energy Strategic Defense Initiative programs: Potential programmatic and facility impacts due to a prospective defense and space treaty.** Hoppler, D.E. Science Applications International Corp., McLean, VA (USA). 10 May 1990. 35p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC01-88DP50066. Order Number DE90012717. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of the following paper is to provide the DOE an analysis of the potential, but reasonably expected, impacts on DOE SDI-related programs resulting from alternative Defense & Space Treaty/Protocol outcomes. DOE facility impacts due to the implementation of Predictability and Confidence-Building Measures currently under negotiation will also be examined.

37555 (DOE/ER/40150–126, pp. 295-302) **Visible wavelength free electron oscillator.** Shoffstall, D.R. (Boeing Aerospace Co., Seattle, WA (USA)). Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings*. Order Number DE90007862. Available from NTIS, PC A99/MF A01.

The overall goal of the visible oscillator program is to demonstrate that a large FEL interaction strength can be obtained at approximately 600-nm wavelength. The gain extraction product

increases with increasing wiggler length, and a 5-m length with hybrid $SmCo_5$ technology was identified at the program start as providing satisfactory interaction strength, reasonable cost, and an acceptable extrapolation from previous wigglers. The 120-MeV LINAC comprises five accelerator sections, each powered by a 12-MW peak output RF klystron power station. The operating frequency is 1.3 GHz. The structure is a constant gradient traveling wave (TW), operating in the $3\pi/4$ mode. A TW design was chosen to accommodate the wide range of beam loading conditions required in the FEL experimental series. The radio frequency (RF) LINAC current format is a series of high-current micropulses spaced at the two way oscillator cavity transit time. The envelope of these pulses, the macropulse, is selected to be long enough to examine the laser startup and beam quality physics, nominally 100-200μs. 9 refs., 5 figs.

37556 (DOE/ER/40150–126, pp. 309-311) **High current RF accelerator for FEL applications.** Price, D. (Physics International Co., San Leandro, CA (USA)); Genuario, R.; Smith, R.; Miller, R. Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility. Jun 1989. (CONF-881049–: 14. linear accelerator conference (LINAC-14), Newport News, VA (USA), 3-7 Oct 1988; CEBAF–89-001). In *1988 linear accelerator conference proceedings*. Order Number DE90007862. Available from NTIS, PC A99/MF A01.

The feasibility of basing free electron lasers in space depends upon reducing the size and weight of all system components to manageable levels. Two of the largest and most complex subsystems in any FEL concept are the accelerator and wiggler. Improvements in these two subsystems can provide a very high payoff. Only two types of accelerators hold promise for high power FELs: the induction linac and the rf accelerator. Both types can produce the high quality (i.e., high brightness and monoenergetic), high voltage (of order 100 to 200 MeV) electron beams needed to drive the FEL wigglers. Of these two, the induction linac concepts suffer size disadvantages because they are designed with relatively low accelerating field, real estate gradients and often use very heavy magnetic materials in acceleration cavities. Their advantage over most rf accelerator concepts is that they produce higher currents. These higher currents (of order a few kiloamps) can simplify the FEL wiggler subsystem by allowing it to operate as a single pass amplifier. At the lower currents typical of existing rf accelerator concepts, the wiggler must be configured as a master oscillator that requires a large and complex ring resonator and either grazing incidence optics or gas lenses. 1 ref., 4 figs.

37557 (SAND–89-2928C) **Guidance and targeting for the strategic target system.** White, J.E. Sandia National Labs., Albuquerque, NM (USA). 20 Nov 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900861–1: 1990 guidance, navigation and control conference, Portland, OR (USA), 20-22 Aug 1990). Order Number DE90005239. Available from NTIS, PC A02/MF A01 - OSTI.

Guidance algorithms and targeting procedures for the Strategic Target System (STARS) launch vehicle are described. The STARS vehicle is a three stage booster, based partly upon retired Polaris A3 missile assets, which is intended to support development and testing of the Strategic Defense Initiative by delivering target payloads to the vicinity of the Kwajalein Atoll. STARS will be launched from the Kauai Test Facility located on Kauai, Hawaii. The STARS guidance objective is to deliver payloads to a prescribed target location with maximum accuracy at inter-continental ballistic missile velocities. The guidance problem is complicated by the fact that all three stages lack thrust termination or other velocity control mechanisms, and by range safety requirements for one or more out-of-plane turns. Mission objectives are achieved with a combination of guidance algorithms. The original Polaris guidance is used during the atmospheric ascent phase. The powered-explicit-guidance used by the Space Shuttle is later employed to execute an out-of-plane turn and to place the third stage as closely as possible into the desired coast trajectory. Third stage targeting is a modified Lambert procedure formulated to eliminate the target miss due to off-nominal ascent phase performance. Active guidance is also used during the third stage burn to maximize the delivery accuracy. 10 refs., 7 figs., 3 tabs.

4506 Chemical and Biological

Refer also to citation(s) 37617, 37618

37558 (AD-A–217970/3/XAB) **Effects of a modified through-mask drinking system (MDS) on fluid intake during exercise in chemical protective gear. Report for January-May 1989.** Szlyk, P.C.; Sils, I.V.; Tharion, W.J.; Francesconi, R.P.; Mahnke, R.B. Army Research Inst. of Environmental Medicine, Natick, MA (USA). 12 Oct 1989. 40p. (USARIEM-T–1-90). Available from NTIS, PC A03/MF A01.

This study was designed to evaluate the effects of a modified through-mask drinking system (MDS) on voluntary fluid consumption. Eighteen male volunteers walked on a treadmill (4.02 km/hr, 0 deg. grade, 50 min/hr for 6 hr) in a climatic chamber (dry bulb=32.6 deg C, wet bulb=17.5 deg C, 20.4% relative humidity, and windspeed=8.05 km/hr, producing a WBGT of 22.1 deg C). Subjects wore chemical protective gear (trousers, jacket, boots, gloves, and M17A1 protective mask) and were randomly assigned one of two through-mask and were randomly assigned one of two through-mask drinking systems: CS (n=9), the current gravity fed system or MDS (n=9), a prototype hand-pump drinking system. Because decontamination of the mask and drinking connections was performed prior to drinking, the overall use of the CS was rated significantly more difficult during both work and rest than the MDS. Failure to decontaminate connections prior to drinking was noted early in the trial in 2 soldiers using the CS suggesting an increase risk of accidental contamination associated with this system. Drinking with the MDS had no measurable adverse effect on hydration status of the test subjects: water intake rate, 0.36 L/hr (CS) and 0.42 L/hr (MDS); sweat rate, 0.63 L/hr (CS) and 0.67 L/hr (MDS); body weight loss, 0.32 %/hr (CS) and 0.31 %/hr (MDS).

37559 (DOE/DP/50066–T7) **Constitutional implications of implementing a chemical weapons convention.** Carnahan, B. Science Applications International Corp., McLean, VA (USA). 4 Apr 1990. 38p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC01-88DP50066. Order Number DE90012716. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

While the United States Constitution declares treaties to be the "supreme Law of the Land," most treaties the United States enters into require the Congress to enact legislation to fully implement the treaty's terms in American law. The implementing legislation for the Chemical Weapons Convention will be very detailed and complex. In addition, this legislation must not conflict with any of the provisions of the Constitution. Much discussion has already taken place on the problem of ensuring access to private property during systematic inspections of Schedule 2 facilities and challenge inspections of other facilities. The problem is usually framed in terms of reconciling the Convention with the Fourth Amendment's prohibition on "unreasonable searches and seizures." Even if the Convention includes a right of refusal for challenge inspections, the political costs of invoking such a right will require the government to seek some means of obtaining access to private property during inspections, so that the right of refusal is used only as a last resort. This document provides a discussion of the legal, constitutional, and political aspects of implementing chemical weapons convention legislation. 32 refs.

37560 (ORNL–6615) **Evaluating protective actions for chemical agent emergencies.** Rogers, G.O.; Watson, A.P.; Sorensen, J.H.; Sharp, R.D.; Carnes, S.A. Oak Ridge National Lab., TN (USA). Apr 1990. 314p. Sponsored by U.S. Department of Defense; U.S. Federal Emergency Management Agency. DOE Contract AC05-84OR21400. Order Number DE90012030. Available from NTIS, PC A14/MF A01 - OSTI; GPO Dep.

In the process of completing a Congressionally mandated destruction of the US stockpile of unitary chemical weapons, the US Army decided that enhanced emergency planning was needed to reduce the consequences of an accidental release of agent. This research supports that efforts by developing a method of evaluation for the principle protective action alternatives-evacuation, in-place shelter, and respiratory protection. A model was developed to examine the effect various protective actions have on expected exposure under a variety of release and meteorological conditions. This report analyzed a total of 1134 scenarios. This preliminary

analysis focused on 14 classes of accidents, for a range of meteorological condition, and for a series of downwind distances. These 126 accident scenarios were examined for emergency responses involving evacuation, in-place shelter, and respiratory protection. All of the scenarios examined assumed that the protective actions would be implemented in the context of a state-of-the-art emergency response system. Such a system is characterized as being able to detect and assess an accident, communicate that to off-site officials and make a decision to warn the public in five minutes or less; have both indoor and outdoor emergency warning systems, such as siren and telephone ring-down systems; stimulate public response at a rate that is 25% faster than previous disasters, including response to five chemical evacuations. 144 refs., 45 figs., 32 tabs.

37561 (ORNL–6628) **Reentry planning: The technical basis for offsite recovery following warfare agent contamination.** Watson, A.P.; Munro, N.B. Oak Ridge National Lab., TN (USA). Apr 1990. 153p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. Order Number DE90012007. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

In the event on an unplanned release of chemical agent during any stage of Chemical Stockpile Disposal Program (CSDP), the potential exists for contamination of drinking water, forage crops, grains, garden produce and livestock. Persistent agents, such as VX or sulfur mustard, pose the greatest human health concern for reentry. The purpose of this technical support study is to provide information and analyses that can be used by federal, state and local emergency planners in determining the safety or reentry to, as well as the potential for recovery of, contaminated or suspect areas beyond the installation boundary. Guidelines for disposition of livestock, agricultural crops and personal/real property are summarized. Advisories for ingestion of food crops, water, meat and milk from the affected zones are proposed. This document does not address potential adverse effects to, or agent contamination of, wild species of plants or animals. 80 refs., 4 figs., 29 tabs.

54 ENVIRONMENTAL SCIENCES

5401 Environmental Sciences, Atmospheric

Refer also to citation(s) 36707, 36710, 36798, 36829, 36973, 37017, 37019, 37123, 37130, 37561, 37617, 37618, 37622, 37624, 37665, 37667, 37679

37562 (CNIC–00181) **Evaluation of radiation dose for radiological impact of airborne effluents of a coal-fired power plant.** Fu Rongchu (Suzhou Medical Coll., JS (China)); Song Miaofa. China Nuclear Information Centre, Beijing, BJ (China). Mar 1988. 7p. (In Chinese). (SMC–0021). Order Number DE90631204. Available from NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

According to activity concentrations of air, depositions and their distributions in the area around a large coal-fired power plant within a radius of 100 km and relative dose calculation models, annual individual body dose equivalents and collective dose equivalent are estimated. An annual individual body dose equivalent of 3.13×10^{-4} Sv · (GW · a)$^{-1}$ is found at the maximum polluted point. It includes 3.02×10^{-4} Sv · (GW · a)$^{-1}$ from food ingestion, 8.14×10^{-6} Sv · (GW · a)$^{-1}$ from air inhalation, 2.94×10^{-6} Sv · (GW · a)$^{-1}$ from external exposure resulted by depositions. Collective dose equivalent of the area is to be 0.35 man-Sv · (GW · a)$^{-1}$. It is a sum of 26.5 man-Sv · (GW · a)$^{-1}$ from ingestion, 3.70 man-Sv · (GW · a)$^{-1}$ from inhalation and 0.34 man-Sv · (GW · a)$^{-1}$ from external exposure.

37563 (CONF-891292–1) **Global climate change and human health: Information needs, research priorities, and strategic considerations.** Farrell, M.P. (Oak Ridge National Lab., TN (USA)); Kanciruk, P.; O'Hara, F.M. Jr. Oak Ridge National Lab., TN (USA). [1989]. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Global atmospheric change and public health conference; Washington, DC (USA); 5-6 Dec 1989. Order Number DE90012599. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The US Global Research Plan and the International Geosphere-Biosphere Programme were created to assess the effects of global climate change but have not been able to devote much attention to the consequences climate change will have on human health and welfare. Although researchers and policy makers recognize that climate change will have complex effects on resources, in general, the social and medical sciences have not received appropriate international attention under the banner of global change. To address this imbalance, the public health research community needs to launch a international coordinated effort so that the social and medical sciences are as fully represented as other scientific disciplines. This document discusses the information needs, research priorities and strategic considerations of the global change and its impact on human health.

37564 (DOE/EH–90) **Naval Petroleum Reserve No. 3, Naval Oil Shale Reserves Nos. 1, 2, 3: Site environmental report, CY 1989.** Brown, J. Brown (John) E and C, Inc., Casper, WY (USA). May 1990. 19p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE90012533. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A site environmental report on the Naval Petroleum reserve in Wyoming (#3) and the Naval Oil Shale Reserve in Colorado and Utah (#1,2,3) is presented. A brief site characterization precedes a summary on compliance assessment with environmental policy concerning waste management, environmental quality, and spill prevention/control measures. 6 figs., 6 tabs. (CBS).

37565 (DOE/ER–0459T) **Simulating climate with two different numerical schemes.** Gutowski, W.J. (Atmospheric and Environmental Research, Inc., Cambridge, MA (USA)); Iacono, M.J.; Xin-Zhong, Liang; Wang, Wei-Chyung. Atmospheric and Environmental Research, Inc., Cambridge, MA (USA). Jun 1990. 57p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER60422. Order Number DE90011777. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

We compare climate simulations from two models that are identical except that one uses gridpoint techniques and the other spectral techniques for the numerical treatment of atmospheric dynamics. Our purpose is not to determine which technique is better but to indicate the dependence of climate simulation on model numerics. Simulations of a perpetual July are performed using spectral and gridpoint dynamics codes coupled to the Oregon State University model's two-layer atmospheric physics. 31 refs., 28 figs.

37566 (DOE/EV/10053–T1) **Research on CO_2-induced climate change: Final report.** Schlesinger, M.E.; Oh, Jai-Ho; Jiang, Xingjian; Zhao, Zong-ci; Vickers, D. Oregon State Univ., Corvallis, OR (USA). Aug 1988. 51p. Sponsored by U.S. DOE Energy Research; National Science Foundation. DOE Contract AI01-78EV10053. Grant ATM 8511889. Order Number DE90012478. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This final report describes research performed during 1 July 1985–1 January 1988. This research can be subdivided into two components: the simulation and analysis of CO_2-induced climate change, and the development of an advanced atmospheric GCM. The research performed under the first component consisted of the simulation of $1 \times CO_2$ and $2 \times CO_2$ equilibrium climates by the OSU 2-layer atmospheric GCM/mixed-layer ocean model, the analysis of these simulated $1 \times CO_2$ and $2 \times CO_2$ equilibrium climates, and the analysis of the CO_2-induced transient climate change. The research performed under the second component consisted of the development of a multi-layer GCM, the design of a physically-based parameterization of clouds, the design of a solar radiation parameterization employing the two-stream and delta-Eddington approximations for multiple scattering, and the analysis of the International Satellite Cloud Climatology Program (ISCCP) data. 43 refs., 17 figs., 1 tab.

37567 (DOE/NV/10630–8) **Onsite environmental report for the Nevada Test Site, January 1988–December 1988.** Gonzalez, D.A. Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA). Health Physics Dept. Dec 1989. 234p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-89NV10630 ;AC08-84NV10327. Order Number DE90012182. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

This report documents environmental monitoring at the Nevada Test Site (NTS) as conducted by the Department of Energy (DOE) onsite radiological safety contractor from January 1988 through December 1988. It presents results and evaluations of radiological and non- radiological measurements in air and water, and of direct gamma radiation exposure rates. The radiological monitoring results for CY-1988 reveal that the concentrations of radionuclides in air and water on the Nevada Test Site were far below the allowable limits set forth in the DOE guidelines. Contaminated waters contained measurable amounts of tritium and some ^{239}Pu. Effluent measurements were maintained and reported to the DOE. Drinking water and air pollution permits were obtained and maintained during CY-1988 as part of the continual monitoring of non-radiological substances. Dose results to workers performing light activity work at stations possessing maximum concentration averages were calculated and the data indicated that minimum doses were obtained as the result of NTS activities. 31 refs., 27 figs., 34 tabs.

37568 (EGG–10617-7002) **[Workshop on artificially ionized layers in the atmosphere]: Foreign trip report, October 5–14, 1989.** Tunnell, T.W. EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations. 30 Oct 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-88NV10617. (LAO–2732-1856). Order Number DE90013470. Available from NTIS, PC A02/MF A01 - OSTI.

I presented our report which described our technique of inferring electron temperature in a microwave induced plasma. The primary purpose of my trip to Kiev was to present a paper entitled "Analysis of Nitrogen Light Emission from Artificially Ionized Layers (AIL) Breakdown" at the AIL workshop. The AIL concept is to produce an ionized layer in the atmosphere from which radio frequency waves can be reflected. The workshop provided for the transfer of unclassified technology between the US and the USSR, who are reportedly years, if not decades, ahead of the US in this area of research.

37569 (FRCEA-TH–264) **Contribution on the study of light non methane hydrocarbons sources in the atmosphere.** Kanakidou, M. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF); Paris-7 Univ., 75 (France). 1988. 190p. (In French). Order Number DE90501067. Available from NTIS (US Sales Only), PC A09/MF A01.

Non methane hydrocarbons (NMHC) are important in the budget of oxidants species in the troposphere and especially of ozone and hydroxyl radicals. In order to estimate the influence of NMHC, we need to evaluate their production rates from natural and anthropogenic sources and to distinguish also over the oceans the different components of their troposheric background concentrations. In this study, we have determined the production rates of NMHC from different areas, such as soil of tropical forest, rural areas, surface of the ocean. These sources produce several hydrocarbons of different reactivities and each source can be characterized by the proportions of the NMHC emitted. On the whole, the continental emissions are not homogeneous but each source has a specific NMHC composition. Surface sea water shows only small variability in its NMHC composition. In this work, we established that the gas transport from the sea surface to the lower troposphere occurs according to non steady state processes. However, the steady state hypothesis can be used under very stable atmospheric conditions such as are observed under the canopy of an equatorial forest or into the temperature inversion layers near the ground. In such cases, using the vertical distribution of the NMHC, simple assumptions lead us to deduce their lifetimes and, consequently, an indirect estimation of the hydroxyl radical concentration can be made.

37570 (LA–11735-MS) **Los Alamos climatology.** Bowen, B.M. Los Alamos National Lab., NM (USA). May 1990. 254p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. Order Number DE90011765. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

This report was written for a wide audience of readers, from engineers and scientists to individuals just waiting to know abut Los Alamos weather. For this reason, and because English units are still the standard in National Oceanic and Atmospheric Administration (NOAA) reporting and publications, familiar English units are primarily used in this report. In most tables and graphs, data are presented in English units, such as degrees Fahrenheit (°F), inches, and miles per hour (mph). However, metric units, such as degrees Celsius (centigrade)(°C), centimeters (cm), and meters per second (m/s), are also displayed on second ordinates of most graphs. Only metric units are given for some variables, such as insolation and atmospheric density. In the sections on turbulence and wind persistence, wind speed is given in meters per second because this unit is standard in dispersion meteorology. 76 figs., 73 tabs.

37571 (ORNL/CDIAC–32) **A plan for intermodel comparison of atmospheric CO_2 projections with uncertainty analysis.** King, A.W.; Sale, M.J. Oak Ridge National Lab., TN (USA). Carbon Dioxide Information Analysis Center. Jun 1990. 43p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90011298. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This document is a plan for an intermodel comparison of atmospheric CO_2 projections that includes uncertainty analysis of the global carbon cycle models used to make those projections. The plan includes a procedure for the documentation, support, and archiving of global carbon cycle models within the Carbon Dioxide Information Analysis Center (CDIAC) at Oak Ridge National Laboratory (ORNL). The "best" global carbon cycle model is not one of the objectives. Rather, the principal goals are to develop a picture of where global carbon cycle modeling stands, at present, in the projection of future atmospheric CO_2 concentrations and to acquire information that can be used to determine research needs for CO_2 modeling. The plan involves three phases: model implementation — the acquisition and computer implementation of the global carbon cycle models; model analysis — sensitivity and uncertainty analysis of each model; and synthesis — an intermodel comparison of the projections of future atmospheric CO_2 concentrations and characterization of across-model patterns in the atmospheric projections and associated uncertainties. 40 refs., 7 figs., 1 tab.

37572 (PB–90-191982/XAB) **Progress in the prevention and control of air pollution in 1988: Report to congress. Annual report.** Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. Jan 1990. 181p. (EPA–450/2-90/007). Available from NTIS, PC A09/MF A01.

See also PB–89-196398.

Contents of this study: air quality trends, monitoring, and modeling; air pollution research programs; development of national ambient air; quality standards; assessment and control of toxic air pollutants; status of air quality management programs; control of stationary source emissions; stationary source compliance; control of mobile source emissions; stratospheric ozone protection; indoor air quality; acid deposition; radon assessment and remediation; litigation.

37573 (PB–90-195603/XAB) **Radon-measurement comparison study, Butte, Montana-68 homes.** Office of Radiation Programs, Washington, DC (USA). Jan 1990. 114p. (EPA–520/1-89/034). Available from NTIS, PC A06/MF A01.

This report is the result of an EPA, Office of Radiation Programs study to evaluate sampling and measurement procedures for determining average radon and radon-decay-product concentrations in houses. The report presents the study results and enough information to allow a reader to use and analyze the data. The study plan is described, including the roles of key participants and factors in the study's design. Quality assurance issues, including the calibration of the instruments, their precision, and intercomparisons among laboratories participating in the study are discussed.

37574 (PB–90-195736/XAB) **EIS (Environmental Impact Statement) NESHAPs (National Emission Standards for Hazardous Air Pollutants) for Radionuclides.** Office of Radiation Programs, Washington, DC (USA). Sep 1989. 1732p. Available from NTIS, PC EE99/MF E99.

Set includes PB–90-195744 through PB–90-195777.

The Environmental Protection Agency is promulgating National Emission Standards for Hazardous Air Pollutants (NESHAPs) for

Radionuclides. An Environmental Impact Statement (EIS) has been prepared in support of the rulemaking. The EIS consists of the following three volumes: Volume I - Risk Assessment Methodology. The document contains chapters on hazard identification, movement of radionuclides through environmental pathways, radiation dosimetry, estimating the risk of health effects resulting from exposure to low levels of ionizing radiation, and a summary of the uncertainties in calculations of dose and risks. Volume II - Risk Assessments. The document contains a chapter on each radionuclide source category studied. The chapters include an introduction, category description, process description, control technology, health impact assessment, supplemental control technology, and cost. It has an appendix which contains the inputs to all the computer runs used to generate the risk assessment. Volume III - Economic Assessment. The document has chapters on each radionuclide source category studied. Each chapter includes an introduction, industry profile, summary of emissions, risk levels, the benefits and costs of emission controls, and economic impact evaluations.

37575 (PB–90-195751/XAB) **Risk-assessments Environmental Impact Statement. NESHAPs (National Emission Standards for Hazardous Air Pollutants) for radionuclides. Background information document. Volume 2.** Office of Radiation Programs, Washington, DC (USA). Sep 1989. 563p. (EPA–520/1-89/006-1). Available from NTIS, PC A24/MF A03.

See also Volume 1, PB–90-195744 and Volume 2, Appendixes, PB–90-195769. Also available in set of 4 reports PC E99/MF E99, PB–90-195736.

The publication contains a chapter on each radionuclide source category studied. The chapters include an introduction, category description, process description, control technology, health impact assessment, supplemental control technology, and cost. It has an appendix which contains the inputs to all the computer runs used to generate the risk assessment.

37576 (PB–90-195769/XAB) **Risk-assessments Appendixes Environmental Impact Statement. NESHAPs (National Emission Standards for Hazardous Air Pollutants) for Radionuclides. Background information document. Volume 2. Appendixes.** Office of Radiation Programs, Washington, DC (USA). Sep 1989. 364p. (EPA–520/1-89/006-2). Available from NTIS, PC A16/MF A02.

See also Volume 2, PB–90-195751 and Volume 3, PB–90-195777. Also available in set of 4 reports PC E99/MF E99, PB–90-195736.

The document is the Appendix to Risk Assessments Vol II and it contains the inputs to all the computer runs used to generate the risk assessment.

37577 (PB–90-195777/XAB) **Economic-assessment Environmental Impact Statement. NESPAHs (National Emission Standards for Hazardous Air Pollutants) for radionuclides. Background information document. Volume 3.** Office of Radiation Programs, Washington, DC (USA). Sep 1989. 536p. (EPA–520/1-89/007). Available from NTIS, PC A23/MF A03.

See also Volume 2, Appendixes, PB–90-195769. Also available in set of 4 reports PC E99/MF E99, PB–90-195736.

The document has chapters on each radionuclide source category studied. Each chapter includes an introduction, industry profile, summary of emissions, risk levels, the benefits and costs of emission controls, and economic impact evaluations.

37578 (PB–90-864083/XAB) **Air-pollution tracer studies in the lower atmosphere. May 1985-March 1990 (A Bibliography from the NTIS data base). Report for May 1985-March 1990.** National Technical Information Service, Springfield, VA (USA). Mar 1990. 71p. Available from NTISPC N01/MF N01.

Supersedes PB–88-859178.

This bibliography contains citations concerning the use of a variety of tracers to study lower-atmospheric air-pollution movements. Project descriptions and results, and techniques and materials used are among the topics considered. Tracer movement from nuclear power plants, industrial stacks, and urban areas is discussed. (This updated bibliography contains 110 citations, 48 of which are new entries to the previous edition.)

37579 (PNL–6450-31-HEDR) **Hanford Environmental Dose Reconstruction Project: Monthly report.** Finch, S.M. (comp.). Pacific Northwest Lab., Richland, WA (USA). May 1990. 59p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE90012747. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This monthly report summarizes the technical progress and project status for the Hanford Environmental Dose Reconstruction (HEDR) Project being conducted at Pacific Northwest Laboratory (PNL) under the direction of a Technical Steering Panel (TSP). The TSP is composed of experts in numerous technical fields related to this project and represents the interests of the public. The US Department of Energy (DOE) funds the project. The objective of the Hanford Environmental Dose Reconstruction Project is to estimate the radiation doses that populations could have received from nuclear operations at Hanford since 1944. The project is divided into the following technical tasks. These tasks address each of the primary steps in the path from radioactive releases to dose estimates source terms, environmental transport, environmental monitoring data, demographics, agriculture, and food habits, and environmental pathways and dose estimates.

37580 (SAND–90-0537C) **The greenhouse effect and acid rain: A tutorial.** Traeger, R.K. Sandia National Labs., Albuquerque, NM (USA). 1990. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900823–1: Annual meeting of the Geothermal Resources Council and international symposium on geothermal energy, Kailua Kona, HI (USA), 20-24 Aug 1990). Order Number DE90008347. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The concentrations of carbon dioxide, methane, sulfur dioxide, nitrous oxides and chlorofluorocarbons is increasing in the earth's atmosphere. Increased concentrations of these trace gases could lead to global warming, increased acid rain and increased UV radiation on the earth's surface; however, the actual impacts are still uncertain and are also the subject of great debate. Application of "clean" energy sources such as geothermal are obviously desirable for decreasing these effects and improving our overall general environment. This paper briefly summarizes the global environment concerns, providing a backdrop for the following papers which describe the geothermal role in future environmental considerations. 5 refs., 2 figs., 1 tab.

37581 (TVA/PUB–89/8) **Annual radiological environmental monitoring report, Watts Bar Nuclear Plant, 1989.** Tennessee Valley Authority, Muscle Shoals, AL (USA). Chemistry and Radiological Services. May 1989. 97p. Sponsored by Tennessee Valley Authority. Order Number DE90012822. Available from NTIS, PC A06/MF A01; OSTI; INIS.

This report describes the preoperational environmental radiological monitoring program conducted by TVA in the vicinity of the Watts Bar Nuclear Plant (WBN) in 1989. The program includes the collection of samples from the environment and the determination of the concentrations of radioactive materials in the samples. Samples are taken from stations in the general area of the plant and from areas that will not be influenced by plant operations. Station locations are selected after careful consideration of the weather patterns and projected radiation doses to the various areas around the plant. Material sampled includes air, water, milk, foods, vegetation, soil, fish, sediment, and direct radiation levels. During plant operations, results from stations near the plant will be compared with concentrations from control stations and with preoperational measurements to determine the potential impacts to the public. The exposures calculated from environmental samples were contributed by naturally occurring radioactive materials, from materials commonly found in the environment as a result of atmospheric fallout, or from the operation of other nuclear facilities in the area. Since WBN has not operated, there has been no contribution of radioactivity from the plant to the environment. 4 refs., 2 figs., 1 tab.

37582 (TVA/PUB–89/9) **Annual radiological environmental operating report, Browns Ferry Nuclear Plant, 1989.** Tennessee Valley Authority, Muscle Shoals, AL (USA). Chemistry and Radiological Services. Apr 1990. 112p. Sponsored by Tennessee Valley Authority. Order Number DE90012821. Available from NTIS, PC A06/MF A01; OSTI; INIS.

This report describes the environmental radiological monitoring program conducted by TVA in the vicinity of Browns Ferry Nuclear Plant (BFN) in 1989. The program includes the collection of samples from the environment and the determination of the concentrations of radioactive materials in the samples. Samples are taken from stations in the general area of the plant and from areas not influenced by plant operations. Station locations are selected after careful consideration of the weather patterns and projected radiation doses to the various areas around the plant. Material sampled includes air, water, milk, foods, vegetation, soil, fish, sediment, and direct radiation levels. Results from stations near the plant are compared with concentrations from control stations and with preoperational measurements to determine potential impacts if plant operations. The vast majority of the exposures calculated from environmental samples were contributed by naturally occurring radioactive materials or from materials commonly found in the environment as a result of atmospheric nuclear weapons fallout. Small amounts of Co-60 were found in sediment samples downstream from the plant. This activity in river sediment would result in no measurable increase over background in the dose to the general public. 4 refs., 2 figs., 2 tabs.

37583 (TVA/PUB–89/10) **Annual radiological environmental operating report, Sequoyah Nuclear Plant, 1989.** Tennessee Valley Authority, Muscle Shoals, AL (USA). Chemistry and Radiological Services. Apr 1990. 110p. Sponsored by Tennessee Valley Authority. Order Number DE90012820. Available from NTIS, PC A06/MF A01; OSTI; INIS.

This report describes the environmental radiological monitoring program conducted by TVA in the vicinity of the Sequoyah Nuclear Plant (SQN) in 1989. The program includes the collection of samples from the environment and the determination of the concentrations of radioactive materials in the samples. Samples are taken from stations in the general area of the plant and from areas not influenced by plant operations. Station locations are selected after careful consideration of the weather patterns and projected radiation doses to the various areas around the plant. Material sampled includes air, water, milk, foods, vegetation, soil, fish, sediment, and direct radiation levels. Results from stations near the plant are compared with concentrations from control stations and with preoperational measurements to determine potential impacts of plant operations. The vast majority of the exposures calculated from environmental samples were contributed by naturally occurring radioactive materials or from materials commonly found in the environmental as a result of atmospheric nuclear weapons fallout. Small amounts of Co-60 were found in sediment samples downstream from the plant. This activity in river sediment would result in no measurable increase over background in the dose to the general public. 4 refs., 2 figs., 2 tabs.

37584 (UBA-FB–89-098) **Modelling of the transport of air pollution in orographic regions like Northeast Bavaria.** Graf, J.; Schmid, S. Muenchen Univ. (Germany, F.R.). Meteorologisches Inst.; Umweltbundesamt, Berlin (Germany, F.R.). Jan 1989. 162p. (In German). Contract UFOPLAN-Nr. 10402631/04. Available from Copy held by UB/TIB Hannover.

Available mesoscale models have been improved in order to properly simulate air pollution events in northeast Bavaria during high pressure situations in winter. In particular reactions and dry deposition of chemical reactants have been incorporated. Moreover, a geostrophic wind can be prescribed which depends on time and hight. The meteorological and topographic input as well as the pollutant emission distribution has been provided for selected cases. The agreement of model results and observations in satisfactory in most cases. The simulations allow to assess the pollutant transport across the border as well as the ratio of local and far-field contributions to the level of air pollution. The computation of a flow climatology indicates where the flow field is strongly influenced by the orography. In the Fichtelgebirge region, the effect of specific emittors and long-distance transports is also investigated. (orig.) With 30 refs., 19 tabs., 103 figs.

37585 (UBA-FB–90-025/7) **MAB-project 6 'Research for the ecological system Berchtesgaden': Climatological measurements at the Alpine National Park, wind systems and inversions. Disciplinary report FB 07 climatology.** Hofmann, G. Deutscher Wetterdienst, Muenchen (Germany, F.R.); Umweltbundesamt, Berlin (Germany, F.R.). 29 Jul 1988. 268p. (In German). Contract UFOPLAN-Nr. 10401040/05. Available from Copy held by UB/TIB Hannover.

The disciplinary report consists of a statement of the appearance of wind-systems and inversions in summer 1985. Out of it could be taken a summary of transport and distribution of air pollution. (orig.) With 51 tabs., 66 figs.

37586 (UCRL–21195) **Conceptualization of TREE: A model of the effects of acid precipitation and air pollutants on the growth of trees: Progress report.** Kercher, J.R.; Cowles, S.; Houpis, J.L.J.; Anderson, P.; Surano, K. Lawrence Livermore National Lab., CA (USA). 27 Jun 1990. 41p. Sponsored by Oregon State University. DOE Contract W-7405-ENG-48. Order Number DE90013057. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Understanding and assessing the effects of acid precipitation and other associated air pollutants, such as ozone, on forests is a primary focus of the Forest Response Program (FRP) of the National Acid Precipitation Assessment Program (NAPAP). The capability to predict or assess the effects of acid precipitation would be enhanced with the development of realistic tree models that incorporate the effects of pollutants. This paper discusses the development of such models. The objective of these models is to predict the dry-matter yield of the various plant components and simulate their development in time as a function of environmental variables and pollutant levels. 65 refs., 12 figs.

37587 (UCRL–53902) **Toward more realistic material models for release and dispersion of heavy gases.** Rodean, H.C. Lawrence Livermore National Lab., CA (USA). Apr 1989. 39p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. Order Number DE90012015. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A mathematical model for the release and dispersion of hazardous materials in the atmosphere necessarily includes a submodel for the materials. Two toxic materials with complex behavior, uranium hexafluoride (UF_6) and nitrogen tetroxide (N_2O_4), are used to illustrate the modeling of phase change in combination with chemical reactions. The properties of these materials, their phase diagrams, the dissociation of N_2O_4 into NO_2, and the reactions on UF_6 and N_2O_4 with water are reviewed. The models presented for mixtures of UF_6 and N_2O_4 with dry and moist air are based on thermodynamic equilibrium, the ideal gas law, temperature-dependent saturation-vapor pressure equations, a temperature-dependent equilibrium constant for the $N_2O_4 = 2NO_2$ reaction, and the reactions of UF_6 and N_2O_4/NO_2 with H_2O. The material model equations are written in terms of pressure ratios and dimensionless parameters. These equations are used to construct equilibrium diagrams with temperature and the mass fraction of the material in the mixture as the coordinates. The properties of the mixtures are illustrated by curves for constant values of vapor mass fraction, extent of N_2O_4 dissociation, and extent of chemical reaction. The last part of the study consists of the solution of heat balance equations for the release of superheated UF_6 that is subsequently mixed with air. These solutions are plotted for three cases: mixing with dry air, mixing with moist air but assuming no chemical reaction, and mixing with moist air with the UF_6-H_2O reaction. The densities of these mixtures relative to ambient air are plotted, and it is shown that only case with positive buoyancy is that with the UF_6-H_2O reaction. 44 refs., 17 figs., 3 tabs.

37588 (UCRL-ID–103443) **Incorporation of an explosive cloud rise code into ARAC's [Atmospheric Release Advisory Capability] ADPIC transport and diffusion model.** Foster, K.T. (Lawrence Livermore National Lab., CA (USA)); Freis, R.P.; Nasstrom, J.S. Lawrence Livermore National Lab., CA (USA). Apr 1990. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. Order Number DE90012995. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The US Department of Energy's Atmospheric Release Advisory Capability (ARAC) supports various government agencies by modeling the transport and diffusion of radiological material released into the atmosphere. ARAC provides this support principally in the

form of computer-generated isopleths of radionuclide concentrations. In order to supply these concentration estimates in a timely manner, a suite of operational computer models is maintained by the ARAC staff. One primary tools used by ARAC is the ADPIC transport and diffusion computer model. This three-dimensional, particle-in-cell code simulates the release of a pollutant into the atmosphere, by injecting marker particles into a gridded, mass-consistent modeled wind field. The particles are then moved through the gridded domain by applying the appropriate advection, diffusion, and gravitational fall velocities. A cloud rise module has been incorporated into ARAC's ADPIC dispersion model to allow better simulation of particle distribution early after an explosive release of source material. The module is based on the conservation equations of mass, momentum, and energy, which are solved for the cloud radius, height, temperature, and velocity as a function of time. 6 refs., 5 figs., 2 tabs.

37589 **Trace elements concentrations at San Juan metropolitan area and at El Yunque peak.** Diaz, F.A. (Universidad Metropolitana, Dept. of Natural Sciences, Rio Piedras, PR (US)); Medina, W. pp. 386 of Proceedings of the 9th Miami international congress on energy and environment. Volume 1-2 (Abstracts). Veziroglu, T.N. Univ. of Miami, College of Engineering, Coral Gables, FL (USA) (1989). (CONF-891210--: 9. Miami international congress on energy and environment, Miami Beach, FL (USA), 11-13 Dec 1989).

Only thirty miles apart, the San Juan metropolitan area and the Luquillo Rain Forest have a different atmosphere. While the atmosphere at the rain forest is very clean the metropolitan area suffers from the pollutants common to any urban center. During the past three years the authors have been operating an aerosol sampling station at San Juan and a similar station with cloud water collection capabilities at El Yunque Peak at the Luquillo Rain Forest. The authors report here some results from these sampling stations that include daily elemental concentrations and an episode of Saharan dust incursion into the Caribbean.

37590 **Cloud albedo, greenhouse effects, atmospheric chemistry, and climate change.** Penner, J.E. (Lawrence Livermore National Lab., CA (USA)). *Journal of the Air and Waste Management Association (USA),* 40(4): 456-461 (Apr 1990). DOE Contract W-7405-ENG-48.

Changes in global atmospheric chemistry and climate are taking place as a result of observed trends in long lived species such as CO_2, CH_4, N_2O, and the CFCs. The continuation of these trends is expected to eventually lead to a major atmospheric warming that might profoundly affect the society we live in. Trends in short-lived species such as NOx and SOx are also suspected. These trend are not as well established, because the shorter-lived species vary spatially and temporally. Trends in NOx would be expected to lead to increases in tropospheric ozone that would add to the warming created by the other greenhouse gases. Trends in NOx could also alter tropospheric OH concentrations that could lead to changes in CH_4 and some of the CFCs. On the other hand, increases in sulfur emissions may alter cloud optical properties. The changes in cloud optical properties could possibly offset the warming expected from increases in greenhouse gases, depending on the role of natural oceanic sulfur emissions. This paper summarizes recent research in these areas and the interactions of climate and atmospheric chemistry.

37591 **Characterizing the occurrence, sources, and variability of radon in pacific northwest homes.** Turk, B.H. (Lawrence Berkeley Laboratory, CA (USA)); Prill, R.J.; Grimsrud, D.T.; Moed, B.A.; Sextro, R.G. *Journal of the Air and Waste Management Association (USA),* 40(4): 498-506 (Apr 1990).

A compilation of data from earlier studies of 172 homes in the Pacific Northwest indicated that approximately 65 percent of the 46 homes tested in the Spokane River Valley/Rathdrum Prairie region of eastern Washington/northern Idaho had heating season indoor radon (^{222}Rn) concentrations above the U.S. EPA guideline of 148 Bq m^{-3} (4 pCi L^{-1}). A subset of 35 homes was selected for additional study. The primary source of indoor radon in the Spokane River Valley/Rathdrum Prairie was pressure-driven flow of soil gas containing moderate radon concentrations (geometric mean concentration of 16,000 Bq m^{-3}) from the highly permeable soils (geometric mean permeability of 5×10^{-11} m^2) surrounding the house substructures. Estimated soil gas entry rates ranged from 0.4 to 39 m^3h^{-1} and 1 percent to 21 percent of total building air infiltration. Radon from other sources, including domestic water supplies and building materials was negligible. In high radon homes, winter indoor levels averaged 13 times higher than summer concentrations, while in low radon homes winter levels averaged only 2.5 times higher. Short-term variations in indoor radon were observed to be dependent upon indoor-outdoor temperature differences, wind speed, and operation of forced-air furnace fans. Forced-air furnace operations, along with leaky return ducts and plenums, and openings between the substructure and upper floors enhanced mixing of radon laden substructure air throughout the rest of the building.

37592 **A rapid response air quality analysis system for use in projects having stringent quality assurance requirements.** Bowman, A.W. (Battelle Project Management Division, Hereford, TX (USA)). *Journal of the Air and Waste Management Association (USA),* 40(4): 507-510 (Apr 1990).

This paper describes an approach to solve air quality problems which frequently occur during iterations of the baseline change process. From a schedule standpoint, it is desirable to perform this evaluation in as short a time as possible while budgetary pressures limit the size of the staff available to do the work. Without a method in place to deal with baseline change proposal requests the environment analysts may not be able to produce the analysis results in the time frame expected. Using a concept called the Rapid Response Air Quality Analysis System (RAAS), the problems of timing and cost become tractable. The system could be adapted to assess other atmospheric pathway impacts, e.g., acoustics or visibility. The air quality analysis system used to perform the EA analysis (EA) for the Salt Repository Project (part of the Civilian Radioactive Waste Management Program), and later to evaluate the consequences of proposed baseline changes, consists of three components: Emission source data files; Emission rates contained in spreadsheets; Impact assessment model codes. The spreadsheets contain user-written codes (macros) that calculate emission rates from (1) emission source data (e.g., numbers and locations of sources, detailed operating schedules, and source specifications including horsepower, load factor, and duty cycle); (2) emission factors such as those published by the U.S. Environmental Protection Agency, and (3) control efficiencies.

37593 **Ab initio SCF studies of the electronic structures of halogen nitrates. 2. FNO_x (x = 1, 2, 3).** Walker, G.A. (Atlanta Univ. Center, GA (USA)); Jones, P.; Cao, Yu; Bhatia, S.C.; Morris, V.; Hall, J.H. Jr. *Journal of Physical Chemistry (USA),* 93(20): 7071-7074 (5 Oct 1989).

Self-consistent field calculations have been performed on the compounds FNO_x (x = 1, 2, 3) using 4-31G, 6-31G*/MP2, and PDZ/MP2 basis sets. Dipole moments, Koopman's ionization potentials, and predicted geometries are reported. The predicted relative stability for FNO_2 isomers is FNO_2 > c-FONO > t-FONO. $FONO_2$ is predicted to only slightly prefer a planar configuration in agreement with experiment. The $FONO_2$ isomer is more stable than FOONO by about 40 kcal/mol.

5402 Environmental Sciences, Terrestrial

Refer also to citation(s) 36795, 36901, 36952, 36973, 37561, 37567, 37579, 37581, 37582, 37583, 37591, 37617, 37618, 37620, 37622, 37624, 37679, 37687

37594 (BR–85(7.26-Suppl.)) **Hydric hammocks: A guide to management.** Simons, R.W. (Florida Museum of Natural History, Gainesville, FL (USA)); Vince, S.W.; Humphrey, S.R. Fish and Wildlife Service, Washington, DC (USA); National Wetlands Research Center, Slidell, LA (USA); Florida Museum of Natural History, Gainesville, FL (USA). Sep 1989. 89p. Sponsored by U.S. Department of the Interior. Available from NTIS, PC A; OSTI; Publications Unit, U.S. Fish and Wildlife Service, 18th and C Streets, N.W., Mail Stop 1111, Arlington Square Building, Washington, DC 20240.

The emphasis of this guide is on hydric hammock, a distinctive type of forested wetland occurring at low elevations along the gulf coast of Florida from Aripeka to St. Marks and at various inland sites in Florida. This is companion volume to a descriptive profile of the same community. Relatively little research has been conducted on hydric hammock. Consequently, no systematic way of defining management options of judging their efficacy has been available. The purpose of this guide is to explain how the nature and functioning of the hydric-hammock community determines its best management. Information for the guide was gathered from published and unpublished literature, from personal communication with many technical experts, and from our own field experience. Because little has been published about hydric hammocks, much of this report is based on subjective opinions of ecologists, foresters, and land managers, including the authors, who have worked with and studied this habitat, and on extrapolation of information from other, similar habitats. It is hoped that the content and format of this report will be useful to a broad spectrum of users including other scientists, students, resource managers and planners, teachers, and interested citizens. The document includes a brief description of the community, a history of it use, its present functions and alterations, and the available management techniques and options. 155 refs., 31 figs., 12 tabs.

37595 (CONF-9006200–1) **Distribution, habitat and habits of the desert tortoise (Gopherus agassizii) in the eastern Mojave Desert.** Esque, T.C. (National Ecology Research Center, Fort Collins, CO (USA)); Bury, R.B.; Medica, P.A. Reynolds Electrical and Engineering Co., Inc., Mercury, NV (USA). [1990]. 21p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-89NV10630. From 1990 American Society of Ichthyologists and Herpetologists (ASIH) conference; Charleston, SC (USA); 16 Jun 1990. Order Number DE90012517. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The desert tortoise is widely distributed across most of southern Nevada below 1500 meters elevation and then ranges northeast into the Arizona Strip and southwestern Utah. There are several large populations, but also many isolated groups of desert tortoises due to the rugged topography and, possibly, unsuitable soils. We suggest that the greatest threats to tortoises in the eastern Mojave Desert are with peripheral populations. Tortoises in the eastern Mojave Desert occupy a wide variety of habitats from flats and bajadas in lower elevation to rocky slopes bordering on blackbrush and juniper woodland. In winter they use shallow burrows near Las Vegas but frequent deep caves in the northeast edge of their range. Tortoises in all areas may occur in steep, rocky habitats. Climatic extremes are frequent in this region and rainfall can be spotty due to several major mountain ranges that cause rain shadows. Forage is highly variable and this species can be an opportunistic herbivore. 11 refs., 13 figs.

37596 (DOE/NV/10384–23-Rev.) **Off-Site Radiation Exposure Review Project: Phase 2 soils program: Revision.** McArthur, R.D.; Miller, F.L. Jr. Nevada Univ., Las Vegas, NV (USA). Water Resources Center. Dec 1989. 206p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-85NV10384. Order Number DE90012890. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

To help estimate population doses of radiation from fallout originating at the Nevada Test Site, soil samples were collected throughout the western United States. Each sample was prepared by drying and ball-milling, then analyzed by gamma-spectrometry to determine the amount of ^{137}Cs it contained. Most samples were also analyzed by chemical separation and alpha-spectrometry to determine $^{239+240}Pu$ and by isotope mass spectroscopy to determine the ratios of ^{240}Pu to ^{239}Pu and ^{241}Pu to ^{239}Pu. The total inventories of cesium and plutonium at 171 sites were computed from the results. This report describes the sample collection, processing, and analysis, presents the analytical results, and assesses the quality of the data. 10 refs., 9 figs., 12 tabs.

37597 (GKSS–89/E/50) **Transport processes of suspended matter derived from time series in a tidal estuary.** Grabemann, I. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.)); Krause, G. GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.). 1989. 8p. Available from Also published in J. Geophys. Res., C (15 Oct 1989) v. 94(10) p. 14373-14379.

Optical beam transmittance meters integrated into Aanderaa current meters were used to measure long time series of suspended matter concentration simultaneously with current velocity and salinity in the turbidity maximum of the Weser estuary (shallow coastal plain estuary of the North Sea). They cover the spectrum from 10 min to several months. The time histories of concentrations and fluxes are discussed for characteristic locations within the turbidity maximum. The analyses demonstrate that the tidal dynamics of deposition into and resuspension of particles from temporally and spatially limited material sources at the bottom is the dominant process in the turbidity maximum while the nontidal gravitational circulation acts as a long-term source and sink. There is a remarkable repeatability of concentration patterns during similar discharge conditions. (orig.).

37598 (NIRS-RSD–86) **Radioactivity survey data in Japan, part 1: Environmental materials.** National Inst. of Radiological Sciences, Chiba (Japan). Oct 1989. 32p. Order Number DE90798893. Available from NTIS (US Sales Only), PC A03/MF A01.

The report presents data obtained through a radioactivity survey. Various environmental and dietary materials are collected for analysis. Rain and dry fallout are collected monthly. Airborne dust is collected every three months. Service water samples are taken semiyearly. Freshwater is taken once a year (fishing season). Soil samples are taken once a year from two layers at different depths. Sea water is collected once a year at fixed stations where the effect of terrestrial fresh water from rivers is expected to be negligibly small. Sea sediments are collected once a year in the same area as that for the sea water sample. A full one day ordinary diet including three meals, water and tea for five persons is collected semiyearly as a sample of 'total diet'. Polished rice is collected in producing districts and in consuming areas. Raw milk is collected in producing districts and commercial milk is purchased in consuming districts. Vegetable are collected once a year in producing and consuming districts. Tea samples are also collected once a year. Fish, shellfish and seaweeds are collected once a year. Test solutions are prepared from these samples. Strontium-90 and cesium-137 are separated and subjected to quantitative determination. Results obtained are tabulated. This part (Part 2) presents data on environmental materials. (N.K.).

37599 (NUREG/CR–5377) **Review of the chronic exposure pathways models in MACCS [MELCOR Accident Consequence Code System] and several other well-known probabilistic risk assessment models.** Tveten, U. (Institutt for Energiteknikk, Kjeller (Norway)). Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Institutt for Energiteknikk, Kjeller (Norway). Jun 1990. 102p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A06/MF A01 - GPO; OSTI; INIS.

The purpose of this report is to document the results of the work performed by the author in connection with the following task, performed for US Nuclear Regulatory Commission, (USNRC) Office of Nuclear Regulatory Research, Division of Systems Research: MACCS Chronic Exposure Pathway Models: Review the chronic exposure pathway models implemented in the MELCOR Accident Consequence Code System (MACCS) and compare those models to the chronic exposure pathway models implemented in similar codes developed in countries that are members of the OECD. The chronic exposures concerned are via: the terrestrial food pathways, the water pathways, the long-term groundshine pathway, and the inhalation of resuspended radionuclides pathway. The USNRC has indicated during discussions of the task that the major effort should be spent on the terrestrial food pathways. There is one chapter for each of the categories of chronic exposure pathways listed above.

37600 (ORNL/TM–11502) **Report of a workshop on using remote sensing to estimate land use change.** Dale, V.H. (ed.). Oak Ridge National Lab., TN (USA). Apr 1990. 54p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90011278. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Environmental Sciences Division Publication No. 3397.

A workshop, held in Washington, DC, February 22–24, 1989, assembled leading international researchers to discuss recent research results and to identify short- and long-term research objectives that use remote sensing to improve estimates of the carbon flux to the atmosphere caused by changes in land use. Research summaries included remote sensing studies to estimate changes in land area, amount of biomass burning and its effect on atmospheric CO_2, and areas of human disturbances. Research strategies to estimate changes in land use that affect the CO_2 flux were discussed. Working groups were formed to concentrate on the specifics of the research strategy, the relation of remote sensing to other research activities, and the collaborative aspects of the remote sensing research. This report presents the findings of the working groups. 69 refs., 5 figs., 1 tab.

37601 (PNL–7379) **Basalt Waste Isolation Project exploratory shaft site: Final reclamation report.** Brandt, C.A.; Rickard, W.H. Jr. Pacific Northwest Lab., Richland, WA (USA). Jun 1990. 36p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC06-76RL01830. Order Number DE90012746. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The restoration of areas disturbed by activities of the Basalt Waste Isolation Project (BWIP) constitutes a unique operation at the US Department of Energy's (DOE) Hanford Site, both from the standpoint of restoration objectives and the time frame for accomplishing these objectives. The BWIP reclamation program comprises three separate projects: borehole reclamation, Near Surface Test Facility (NSTF) reclamation, and Exploratory Shaft Facility (ESF) reclamation. The main focus of this report is on determining the success of the revegetation effort 1 year after work was completed. This report also provides a brief overview of the ESF reclamation program. 21 refs., 7 figs., 14 tabs.

37602 (RUU-GIA–1989) **Reversibility of interaction of cesium with clay minerals, mud suspensions, and sediments of Dutch surface water bottom: Final report cesium project by request of DBW/RIZA.** Comans, R.M.J.; Haller, M.; Weijden, C.H. van der. DBW/RIZA-Rijksuniversiteit Utrecht Collaboration. Rijksuniversiteit Utrecht (Netherlands). Inst. voor Aardwetenschappen. Jul 1989. 177p. (In Dutch). (DB–255). Available from Library KNAW; P.O. Box 41950, 1009 DD Amsterdam (Netherlands).

The interaction (sorption) processes of cesium in mud-water systems freshwater conditions have been characterized. Emphasis lays on the determination of the reversibility of the processes. Much attention has been paid on desorption- and isotopic exchange processes. The experimental conditions, which have been used, are intended to approximate the natural chemical conditions of surface waters as close as possible. The reversibility of the sorption processes have been tested by following the desorption process, after the adsorption process, under exactly the same conditions, e.g. in a fresh water solution of the same composition but without dissoluted cesium. Also the isotopic exchangeability of adsorbed (stable) cesium with ^{137}Ce has been determined; a parameter which reflects the fraction of the adsorbed cesium being in 'kinetic equilibrium' with the solution. Also the exhange has been studied of adsorbed cesium with ions of which the concentrations can be raised in the aquatic environment under certain condition, and which possibly may compete with cesium for sorption locations. In all experiments, in contrast to most published studies of cesium-sorption, relatively long (ca. 2 weeks) equilibration times have been used. In this way the natural contact times between mud and surface waters are approximated more closely. Preceding investigations have demonstrated that cesium adsorbs well on clay minerals and in particular on illite and mica-like clays. This investigation has therefore been split up into two phases. In the first phase experiments have been performed with three reference clay minerals which occur in the Dutch land- and water bottom. In the second phase a number of natural mud materials have been used of locations on Dutch water systems. The experiments with the clay materials form a basis for the interpretation of the sorption behavior of cesium to the heterogeneous natural mud materials.

37603 (SKB-TR–89-22) **Diffusion of Am, Pu, U, Np, Cs, I and Tc in compacted sand-bentonite mixture.** Albinsson, Y. (Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Nuclear Chemistry); Engkvist, I. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Aug 1989. 52p. Order Number DE90631175. Available from NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

In order to predict the diffusion of actinides and fission products through a backfill mixture of sand and clay from a high-level waste repository, the diffusion of the actinides ^{241}Am, ^{239}Pu, ^{237}Np and ^{233}U and the fission products ^{134}Cs, ^{131}I and ^{99m}Tc have been measured in a mixture of 90% silica sand-10% bentonite (MX-80, Wyoming bentonite). The sand-bentonite mixture was compacted to a density of 2000 kg/m^3. The water phase used was an artificial groundwater representative of Swedish deep granitic groundwater (pH≈8, I≈0.01). The apparent diffusivity is in all cases slightly higher than in pure clay. (author).

37604 (SKB-TR–89-24) **Some notes on diffusion of radionuclides through compacted clays.** Eriksen, T.E. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Nuclear Chemistry). Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). May 1989. 27p. Order Number DE90631176. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The apparent diffusivities of some simple cations i.e. Sr^{2+}, Cs^{+} in water saturated bentonite indicates that diffusion takes place both in the pore solution and within the solvation sheath of the exchangeable cations. Data from some earlier diffusion experiments have been re-evaluated and the results suggest that diffusion within the solvation sheath of the exchangeable cations is the dominating mechanism for Sr^{2+} and Cs^{+}. (author).

37605 Proceedings of the 6th national conference on hazardous wastes and hazardous materials. 720p. Hazardous Materials Control Research Institute, Silver Spring, MD (USA) (1989). (CONF-890452–: 6. national conference and exhibition on hazardous wastes and hazardous materials, New Orleans, LA (USA), 12-14 Apr 1989).

This book contained the proceedings of the 6th national Conference on Hazardous wastes and Hazardous materials. Topics covered include: federal and state policy papers, risk assessment, health and endangerment, contaminated groundwater control, treatment, spill control management and tank leakage control.

37606 Acidic deposition on Walker Branch Watershed. Johnson, D.W. (Oak Ridge National Lab., Oak Ridge, TN (US)); Lindberg, S.E. pp. 1-38 of Acidic precipitation: Volume 1. Gas studies. Adriano, D.C.; Havas, M. Springer-Verlag New York Inc., New York, NY (USA) (1989). DOE Contract AC05-84OR21400.

After nearly a decade of atmospheric deposition research on Walker Branch watershed, an experimental watershed in eastern Tennessee, the authors draw several conclusions as to the fate and effects of atmospheric inputs and begin to extrapolate some of the more important processes regulating element fluxes to other ecosystems. On Walker Branch watershed they have found that dry deposition is a very important component of atmospheric deposition, accounting for as much as half of the input of N and S to the ecosystem. Both N and S accumulate within the watershed, but the mechanisms of accumulation differ considerably: N accumulation is due to biological uptake, whereas S accumulation is due to sulfate adsorption onto soils. The authors estimate that the leaching of K^{+}, Ca^{2+}, and Mg^{2+} from the forest canopy has been increased by ≃50% due to acid deposition, but are unable to determine the effects, if any, of this increase on the vitality of the forest at this time.

37607 Estimating nitrogen lost from forest floor during prescribed fires in Douglas-fir/western hemlock clearcuts. Little, S.N. (Pacific Northwest Research Station, Portland, OR (USA)); Ohmann, J.L. *Forest Science (USA)*, 34(1): 152-164 (Mar 1988).

Nitrogen loss from consumption of forest floor was studied on 33 treatment blocks burned on 11 clearcuts in western Washington and western Oregon. In most cases, nitrogen concentration in forest floor did not change significantly following prescribed fire. Change in the amount of nitrogen in forest floor ranged from an increase of 192 kg/ha to a loss of 666 kg/ha. In most cases, nitrogen loss was directly proportional to the amount of forest floor consumed. Total nitrogen loss can therefore be estimated by multiplying expected loss of forest floor by its nitrogen concentration before the burn.

37608 Substrate heterogeneity and regeneration of a swamp tree, Nyssa aquatica. Huenneke, L.F. (Savannah River Ecology Lab., Aiken, SC (USA)); Sharitz, R.R. *American Journal of Botany (USA),* 77(3): 413-419 (Mar 1990).

We investigated physical characteristics of several substrate types in a South Carolina riverine swamp forest, and the effect of those characteristics upon germination and seedling growth of the dominant swamp tree, Nyssa aquatica (water tupelo). Substrates were categorized as emergent (surfaces of trees, living cypress knees, stumps, or logs), protected (submerged sediment adjacent to an emergent object), or open (sediment > 50 cm from any emergent object and fully submerged during the growing season). Water tupelo seeds germinated best (> 25% in 16 days) on emergent substrates, but seed predation was extremely high on these same substrates. Substrate types differed significant in permanence and in rates of sediment loss or deposition. Growth rates of transplanted seedlings did not differ among substrate types. The result suggest that mortality due to erosional scour or impermanent rooting zones, superimposed on germination patterns, is responsible for the observed nonrandom distribution of woody plant seedlings among substrate types in the swamp forest.

37609 Root and foliar nutrient concentrations in loblolly pine: Effects of season, site, and fertilization. Adams, M.B. (Oak Ridge National Lab., TN (USA)); Campbell, R.G.; Allen, H.L.; Davey, C.B. *Forest Science (USA),* 33(4): 984-996 (Dec 1987).

Nitrogen (N) and phosphorus (P) concentrations in the roots and foliage of plantation-grown loblolly pine were examined over a period of 18 months. Samples were collected from 4 sites on the lower coastal plain of North Carolina, each representing a distinct combination of soil moisture and soil fertility. The patterns in foliar and root nutrient concentrations followed similar trends over the course of this study. However, seasonal trends were irregular, suggesting that annual climatic variation may affect seasonal nutrient levels. Nutrient concentrations varied among sites, as did effects of fertilization (225 kg N ha^{-1}, 225 kg N ha^{-1} + 75 kg P ha^{-1}) on nutrient concentrations. Significant fertilizer effects on nutrient concentrations did not always result in increased volume growth. On some sites, root N and P concentrations appeared to be more sensitive to fertilizer-induced changes than did foliar nutrient levels and may have integrated site factors more effectively than foliar concentrations. Foliage seemed more sensitive of N deficiencies, while the roots detected P deficiencies more often.

37610 Constraints on tree breeding: Growth tradeoffs, growth strategies, and defensive investments. Loehle, C.; Namkoong, G. *Forest Science (USA),* 33(4): 1089-1097 (Dec 1987).

Analysis of basic growth processes and between-species trait correlations suggests that because of growth tradeoffs, breeding for growth rate (volume increment) may adversely affect defensive and other properties of trees. This can lead to negative impacts on sawtimber quality and tree life span. Selection for yield and for pathogen resistance may conflict, separate breeding programs may be needed for pulp and sawtimber purposes, and older ages may be more appropriate for selection of plus trees. In order for breeders to consider consequences of selection on tree performance, a means is required of assessing potential adult pathogen resistance and life span. Four methods are proposed for accomplishing this using properties of young trees. The properties of young trees that may correlate with adult performance are (1) wood properties related to defense, (2) wound healing ability, (3) the allometric growth coefficient, and (4) age of sexual maturity.

37611 Effect of manipulation of water and nitrogen supplies on the quantitative phenology of Larrea tridentata (creosote bush) in the Sonoran desert in California. Sharifi, M.R. (Univ. of California, Los Angeles (USA)); Rundel, P.W.; Herman, D.J.; Meinzer, F.C.; Nilsen, E.T.; Virginia, R.A.; Jarrell, W.M.; Clark, P.C. *American Journal of Botany (USA),* 75(8): 1163-1174 (Aug 1988).

Two years of water and nitrogen augmentation experiments on Larrea tridentata (creosote bush) were carried out in a southern Californian warm desert wash plant community. Treatments consisted of control (C), water (W), water and soil nitrogen (W+SN), and soil nitrogen (SN). Quantitative phenological data and microclimate measurements were collected prior to the onset of and during the growth period and treatments. Predawn and midday water potentials were lower in nonirrigated than irrigated individuals. Leaf conductance was higher in irrigate than in nonirrigated shrubs, with a maximum difference of 1 cm s^{-1} observed in July 1984 under relatively low vapor pressure deficit conditions. Leaf production rates were significantly high in the irrigated (W and W+SN) treatments than in the nonirrigated (C and SN) treatments in 1984. Addition of soil nitrogen caused no increased in vegetative growth rates in 1984. In 1985, a drier year, there was only minimal growth during the spring and summer growth periods in the nonirrigated treatments, while the W and W+SN treatments resulted in significantly higher leaf and shoot growth rates. Growth rates in 1985 were significantly higher in the W + SN treatment than in the W treatment. Reproductive growth was higher in the nonirrigated than the irrigated treatments, with the lowest reproductive activity noted in the W treatment.

5403 Environmental Sciences, Aquatic

Refer also to citation(s) 36764, 36795, 36797, 36901, 37561, 37564, 37567, 37579, 37581, 37582, 37583, 37599, 37602, 37605, 37606, 37682

37612 (CONF-900676–8) **Advances in air-stripper technology.** Wilson, J.H. (Oak Ridge National Lab., TN (USA)); Singh, S.P.; Lucero, A.J.; Thomas, C.O.; Ashworth, R.A.; Elliott, M.G.; Counce, R.M. Oak Ridge National Lab., TN (USA). [1990]. 23p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. From 83. annual meeting and exhibition of the Air and Waste Management Association; Pittsburgh, PA (USA); 24-29 Jun 1990. Order Number DE90012169. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The cost for application of air-stripping technology for removal of volatile organic compounds (VOC's) from groundwater has been shown to be relatively insensitive to the cost of the installed capital equipment. In light of this observation, the basis for selection of air stripping equipment may include site-specific requirements without major economic penalties. In this paper, potential advantages for the use of highly efficient packings for traditional packed towers and a commercial rotary gas-liquid contactor are pointed out, and a basis for design is provided. 11 refs., 10 figs.

37613 (CONF-8905327–1) **Sulfur cycling and fluxes in temperate dimictic lakes.** Cook, R.B. (Oak Ridge National Lab., TN (USA)); Kelly, C.A. Oak Ridge National Lab., TN (USA). [1989]. 60p. Sponsored by Environmental Protection Agency; Scientific Committee on Problems of the Environment. DOE Contract AC05-84OR21400. From Sulfur cycling in terrestrial systems and wetlands conference; Ontario (Canada); 22-26 May 1989. Order Number DE90012601. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The factors controlling the biogeochemistry of sulfur (S) in dimictic northern temperate lakes are reviewed. The primary means of sediment S accumulation in lakes is through bacteria sulfate (SO_4^{2-}) reduction coupled with reaction of product sulfide with either iron or organic matter. Accumulation of S by sedimentation of organic S originating from algae may be important for lakes with high primary productivity, for lakes with low concentrations of SO_4^{2-}, or for lakes with unusually low rates of SO_4^{2-} reduction. The purpose of this is to examine the controls on biogeochemical reactions of S in the water column and sediments of temperate dimictic lakes. The processes causing fluxes of S between the water column and the sediments and the atmosphere also will be examined. Because the primary reactions that S undergoes are closely linked to organic matter, this paper will also discuss the interactions of S with the elements predominant in organic matter (carbon, nitrogen, and phosphorus). 150 refs., 7 figs., 5 tabs.

37614 (DOE/ID–10274) **Groundwater Protection Management Program.** Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office. May 1990. 304p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (MISC–90069). Order Number DE90012969. Available from NTIS, PC A14/MF A01 - OSTI; GPO Dep.

DOE Order 5400.1, "General Environmental Protection Program," requires all DOE facilities to establish an integrated Groundwater Protection Management Program (PROGRAM) for groundwater protection and management. This PROGRAM includes the specific Groundwater Protection Management Plans (GPMPs) for the Idaho National Engineering Laboratory, Component Development and Integration Facility, Grand Junction Projects Office, and the West Valley Project Office. The PROGRAM components are outlined and include policy, objectives, strategy, budgetary resources, and DOE-ID organizational responsibilities. In addition, the PROGRAM provides a summary of the GPMP for each DOE-ID managed facility. The GPMPs are an integral and supportive part of the PROGRAM and incorporate PROGRAM activities that fulfill DOE Order 54000.1 requirements. Each facility is unique, and the GPMP was designed to be a comprehensive document that addresses overall groundwater management and protection. The overall objective of the PROGRAM and GPMPs falls within the DOE-ID environmental protection policy by providing a framework to protect the environment and public health. 40 refs., 4 figs.

37615 (DOE/NV/10384–33) **NTS [Nevada Test Site] Mesa recharge study FY 1988: Letter report.** Lyles, B.F.; Mihevc, T.M. Nevada Univ., Reno, NV (USA). Water Resources Center. Mar 1990. 73p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-85NV10384. Order Number DE90012848. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Pahute Mesa is a large geomorphic feature that is located in Areas 19 and 20 of the Nevada Test Site (NTS) and a portion of the Nellis Air Force Range. The identification of radionuclide migration at the U20n site has resulted in an increased interest in the hydrology of Pahute Mesa. An important aspect of groundwater studies is to estimate groundwater recharge from precipitation. Although some meteorological data have been collected on Pahute Mesa, they are not sufficient for making these recharge estimates. The elevation of Pahute Mesa that lies within the boundaries of the NTS ranges from under 6000 ft to over 7000 ft. Accompanying these elevation changes is a variety of plant communities. Vegetation in areas of low elevation is dominated by sagebrush and by pinyon/juniper at the higher elevations. Communities of Gambel oak are interspersed with pinyon/juniper. Varying plant communities on Pahute Mesa are indicative of the nonuniformity of precipitation and soil types. To understand the mechanisms that lead to recharge, it is necessary to know the spatial as well as temporal variation in precipitation. At the same time, the conditions in the soil need to be monitored to determine if the precipitation is, in fact, infiltrating to the critical depth needed to attain groundwater recharge.

37616 (IS-T–1395) **New selective anion-exchange resins for nitrate removal from contaminated drinking water and studies on analytical anion-exchange chromatography.** Lockridge, J.E. Ames Lab., IA (USA). Jan 1990. 105p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-82. Order Number DE90011620. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

New anion exchange resins, with superior selectivity for nitrate, have been developed. The resins are based on the covalent attachment of a quaternary phosphonium group to a polystyrene-divinylbenzene copolymer. Phosphonium resins of composition resin-$R_3P^+A^-$ where R is varied from methyl to pentyl were evaluated for nitrate/sulfate selectivity, capacity and nitrate decontamination of drinking water. A similar series for the quaternary ammonium exchangers was also evaluated. A mixed bed process, where nitrate removal and water softening is accomplished in a single column, was also evaluated. A small piece of silver wire, coated with an insoluble silver salt, works well as a selective potentiometric detector for halide ions in ion chromatography. Several coated electrodes were examined by electron microscopy and their response to various anions evaluated by flow injection analysis. Two methods for the determination of aluminum by anion chromatography are presented. In the first method, a standard excess of fluoride ion is added to the sample. In a second method, aluminum(III) is determined directly by anion chromatography when sodium phthalate is used as an eluent. 63 refs., 30 figs.

37617 (ORNL/M–1175-Vol.1) **Johnston Atoll Chemical Agent Disposal System (JACADS): Volume 1, Final Second Supplemental Environmental Impact Statement (SSEIS) for the storage and ultimate disposal of the European chemical munition stockpile.** Oak Ridge National Lab., TN (USA). Jun 1990. 248p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. Order Number DE90012982. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

This Final Second Supplemental Environmental Impact Statement (SSEIS) to the Johnston Atoll Chemical Agent Disposal System (JACADS) Environmental Impact Statement (EIS) assesses the effects of receiving, storing, and ultimately destructing the United States stockpile of lethal unitary chemical munitions currently stored in the Federal Republic of Germany (FRG) (European stockpile) at the Army's JACADS facility located on Johnston Atoll in the Pacific Ocean. This Final SSEIS addresses the effects of the following proposed European stockpile activities: the transport of the European stockpile from the territorial limit to Johnston Island, the unloading of munitions from transportation ships, the on-island munitions transport and handling, on-island munitions storage, the disposal of munitions in the JACADS facility, the disposal of incineration wastes, and alternatives to the proposed action. This document also updates information in the 1983 EIS and the 1988 SEIS, as appropriate. 46 refs., 10 figs., 9 tabs.

37618 (ORNL/TM–1175-Vol.2) **Johnston Atoll Chemical Agent Disposal System (JACADS) Final Second Supplemental Environmental Impact Statement (SSEIS): Volume 2, Comments received from the public and agencies on the Draft Second Supplemental Environmental Impact Statement (SSEIS).** Oak Ridge National Lab., TN (USA). Jun 1990. 519p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. Order Number DE90012978. Available from NTIS, PC A22/MF A01 - OSTI; GPO Dep.

This Final Second Supplemental Environmental Impact Statement (SSEIS) to the Johnston Atoll Chemical Agent Disposal System (JACADS) Environmental Impact Statement (EIS) assesses the effects of receiving, storing, and ultimately destructing the United States stockpile of lethal unitary chemical munitions currently stored in the Federal Republic of Germany (FRG) (European stockpile) at the Army's JACADS facility located on Johnston Atoll in the Pacific Ocean. This Final SSEIS addresses the effects of the following proposed European stockpile activities: the transport of the European stockpile from the territorial limit to Johnston Island, the unloading of munitions from transportation ships, the on-island munitions transport and handling, on-island munitions storage, the disposal of munitions in the JACADS facility, the disposal of incineration wastes, and alternatives to the proposed action. This document also updates information in the 1983 EIS and the 1988 SEIS, as appropriate. This volume contains reproduced letters from various agencies, reproduced written comments received from the public, and a transcript from the public meeting.

37619 (PB–90-198177/XAB) **Technology evaluation report: SITE program demonstration of the Ultrox International ultraviolet radiation/oxidation technology.** Welshans, G.; Topudurti, K. PRC Environmental Management, Inc., Chicago, IL (USA). Jan 1990. 141p. Available from NTIS, PC A07/MF A01.

This document presents the field-evaluation results of the ultraviolet radiation (UV)/oxidation technology developed by Ultrox International, Santa Ana, California. The field evaluation of the technology was performed at the Lorentz Barrel and Drum (LB&D) site in San Jose, California, under the Superfund Innovative Technology Evaluation (SITE) program from February 27 through March 10, 1989. The UV/oxidation technology uses UV radiation, ozone, and hydrogen peroxide to oxidize organic contaminants present in water. At the LB&D site, this technology was evaluated in treating ground water contaminated with volatile organic compounds (VOCs). The Ultrox system achieved VOC removals greater than 90%. The majority of VOC's were removed through chemical oxidation. However, for a few VOC's, such as 1,1,1-trichloroethane (1,1,1-TCA) and 1,1-dichloroethane (1,1-DCA) stripping also contributed toward removal. The treated ground water met the applicable discharge standards (NPDES) for disposal into a local waterway at 95% confidence level. There were no harmful air emissions from the Ultrox system into the atmosphere.

37620 (PB–90-866633/XAB) **Radium contamination in the environment. January 1972-July 1989 (A Bibliography from Pollution Abstracts). Report for January 1972-July 1989.** National Technical Information Service, Springfield, VA (USA). Apr 1990. 50p. Available from NTISPC N01/MF N01.

This bibliography contains citations concerning the ecological impact of radium contamination in the environment. Topics include radium in drinking and groundwater, disposal of radium contaminated waste solids, radium transport in the food chain, industrial and natural radium sources, radium buildup in the soil, radium contribution to radon pollution, and health effects of radium exposure. Natural radium in geologic formations across the United States, and the role of naturally-occurring radium in contamination are discussed. Government regulations regarding radium in consumer products and drinking water are described. (Contains 92 citations fully indexed and including a title list.)

37621 (TVA/WR/WQ–90/6) **Surface water resources issues analysis: Wheeler Reservoir watershed region.** Cox, J.P. Tennessee Valley Authority, Chattanooga, TN (USA). Water Quality Dept. Feb 1990. 126p. Sponsored by Tennessee Valley Authority. Order Number DE90012823. Available from NTIS, PC A07/MF A01 - OSTI.

This report is one in a continuing series of periodic water resources issues analyses (WRIAs) conducted within the various local drainage basins that comprise the larger Tennessee River drainage basin. These analyses, based primarily upon existing information gathered from a variety of sources, perform several functions: document known or probable water quality issues that should be addressed by TVA or others; identify specific needs for additional information; guide routine surface water monitoring programs; and provide focus for planning and setting priorities for subsequent water quality assessments, mitigative activities, and resource management projects. 4 refs., 1 fig., 16 tabs.

37622 (UBA-FB–89-138) **Influence of reductions in deposition on the degree of acidification of soils and groundwater in forests - assessment of critical loads from the atmosphere. Final report.** Bredemeier, M.; Wiedey, G.A.; Ulrich, B. Goettingen Univ. (Germany, F.R.). Inst. fuer Bodenkunde und Waldernaehrung; Umweltbundesamt, Berlin (Germany, F.R.). Apr 1988. 83p. (In German). Contract UFOPLAN-Nr. 10202613/01. Available from Copy held by UB/TIB Hannover.

The project was a feasibility study for an extensive research program on experimental manipulations in forest ecosystems. The project work comprised preparatory scientific investigations (studies on soil chemical homogeneity of plots), soil mapping, technical and cost planning up to compiling a detailed research proposal to the sponsor of the research programme (Federal Science and Technology Ministery). The project was finished in time and largely successfully. It is documented in the attached report. (orig.) With 123 refs., 21 tabs., 6 figs.

37623 (UCRL–102225) **Uncertainty in exposure and health-risk assessment: An integrated approach.** McKone, T.E.; Bogen, K.T. Lawrence Livermore National Lab., CA (USA). May 1990. 16p. Sponsored by U.S. DOE Defense Programs; Environmental Protection Agency. DOE Contract W-7405-ENG-48. (CONF-900676–9: 83. annual meeting and exhibition of the Air and Waste Management Association, Pittsburgh, PA (USA), 24-29 Jun 1990). Order Number DE90012988. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The goal of this paper is to consider a strategy for evaluating and reducing sources of uncertainty in predictive exposure and health-risk assessments. We focus on the volatile organic chemical tetrachloroethylene (PCE) in California water systems derived from ground water. We divide our analysis into five steps. First, we consider the magnitude and variability of PCE concentrations available in large public water supplies in California. Second, we characterize pathway exposure factors (PEFs) for ground water exposures and estimate uncertainty for each PEF. Third, we consider models describing uptake and metabolism to estimate the relation between exposure and metabolized dose. Fourth, we consider the carcinogenic potency of the metabolized PCE dose. Finally, we combine the results to estimate the overall magnitude and uncertainty of individual risk within the exposed population. 19 refs., 13 figs., 1 tab.

37624 (WHC-EP–0145-2) **Westinghouse Hanford Company environmental surveillance annual report – 200/600 Areas: Calendar year 1989.** Schmidt, J.W.; Huckfeldt, C.R.; Johnson, A.R.; McKinney, S.M. Westinghouse Hanford Co., Richland, WA (USA). Jun 1990. 153p. Sponsored by U.S. DOE Office of Environmental Restoration and Waste Management. DOE Contract AC06-87RL10930. Order Number DE90012640. Available from NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.

This document presents the results of near-field environmental surveillance as performed by Westinghouse Hanford Company in 1989 for the Operations Area of the Hanford Site, Richland, Washington. These activities were conducted in the 200 and 600 Areas to assess operational control on the work environment. Surveillance activities included external radiation measurements and radiological surveys of waste disposal sites, radiological control areas, and roads, as well as sampling and analysis of ambient air, surface water, groundwater, sediments, soil, and biota. 15 refs., 3 figs., 1 tab.

37625 Impact of accelerated sea level rise on coastal energy facilities, U.S.A. Harrison, W. (Argonne National Lab., IL (USA). Energy and Environmental Systems Div.); Santini, D.J. pp. 356 of Proceedings of the 9th Miami international congress on energy and environment. Volume 1-2 (Abstracts). Veziroglu, T.N. Univ. of Miami, College of Engineering, Coral Gables, FL (USA) (1989). (CONF-891210–: 9. Miami international congress on energy and environment, Miami Beach, FL (USA), 11-13 Dec 1989).

The combination of worldwide (eustatic) sea level rise (SLR) and local SLR due to consolidation of sediments or downward crustal movement is termed relative SLR (RSLR). Recent studies indicate that the eustatic component of RSLR (now only about 12 cm/100 yr) will accelerate in the years ahead due to climatic warming. Sea level will rise worldwide as upper layers of the ocean undergo thermal expansion, alpine glaciers melt, fringes of the polar ice sheets melt, and increasing quantities of ice are discharged to the sea by the Antarctic ice sheet. This eustatic SLR will be augmented by ongoing crustal subsidence along numerous stretches of the Atlantic and Gulf coasts of the United States, with attendant threats to existing and planned energy facilities. It is desirable to estimate the costs that could be incurred under various SLR scenarios, out to the year 2030, for such facilities as electric generating stations, petroleum refinery/storage facilities, chemical plants, steel mills, and oil and LNG port facilities.

37626 Microbial biomass and activities associated with subsurface environments contaminated with chlorinated hydrocarbons. Phelps, T.J. (Univ. of Tennessee, Knoxville (USA)); Ringelberg, D.; Hedrick, D.; Davis, J.; Fliermans, C.B. *Geomicrobiology Journal (USA)*, 6(3-4): 157-170 (1988).

Soil microcosms and enrichment cultures from subsurface sediments and ground waters contaminated with trichloroethylene (TCE) were examined. Total lipids, (1-C_{14})acetate incorporation into lipids, and (Me^3H)thymidine incorporation into DNA were determined in these subsurface environments. In heavily TCE-contaminated zones radioisotopes were not incorporated into lipids or DNA. Radioisotope incorporation occurred in sediments both above and below the TCE plume. Phospholipid fatty acids (PLFA) were not detected, i.e., < 0.5 pmol/L in heavily contaminated groundwater samples. In less contaminated waters, extracted PLFA concentrations were greater than 100 pmol/L and microbial isolates were readily obtained. Degradation of 30-100 mg/L TCE was observed when sediments were amended with a variety of energy sources. Microorganisms in these subsurface sediments have adapted to degrade TCE at concentrations greater than 50 mg/L. 34 refs., 4 figs., 4 tabs.

37627 Cokriging model for estimation of water table elevation. Hoeksema, R.J. (Calvin College, Grand Rapids, MI (USA)); Clapp, R.B.; Thomas, A.L.; Hunley, A.E.; Farrow, N.D.; Dearstone, K.C. *Water Resources Research (USA)*, 25(3): 429-438 (Mar 1989). DOE Contract AC05-84OR21400.

In geological settings where the water table is a subdued replica of the ground surface, cokriging can be used to estimate the water table elevation at unsampled locations on the basis of values of water table elevation and ground surface elevation measured at wells and at points along flowing streams. The ground surface elevation at the estimation point must also be determined. In the

proposed method, separate models are generated for the spatial variability of the water table and ground surface elevation and for the dependence between these variables. After the models have been validated, cokriging or minimum variance unbiased estimation is used to obtain the estimated water table elevations and their estimation variances. For the Pits and Trenches area (formerly a liquid radioactive waste disposal facility) near Oak Ridge National Laboratory, water table estimation along a linear section, both with and without the inclusion of ground surface elevation as a statistical predictor, illustrate the advantages of the cokriging model.

37628 **Response of woody swamp seedlings to flooding and increased water temperatures. I. Growth, biomass, and survivorship.** Donovan, L.A. (Savannah River Ecology Lab., Aiken, SC (USA)); McLeod, K.W.; Sherrod, K.C.; Stumpff, N.J. *American Journal of Botany (USA)*, 75(8): 1181-1190 (Aug 1988).

Growth, biomass, and survival of bald cypress (Taxodium distichum [L.] Richard), water tupelo (Nyssa aquatica L.), black willow (Salix nigra Marshall), and button bush (Cephalanthus occidentalis L.) were examined in a 3 x 3 factorial experiment varying water temperatures (Ambient, mid, and high [~ 40 C]) and water levels (drained, saturated, and flooded). Stem diameter and height, biomass, and survivorship for water tupelo and bald cypress were all reduced by the high/flooded treatment. Black willow growth had the greatest variability among nonlethal flooding and temperature treatments, and achieved the greatest biomass of the four species. In the high/flooded treatment, however, only 47% of the black willow seedlings survived and stem diameter, height, and biomass of survivors were greatly reduced. Button bush had intermediate variability of growth to the nonlethal treatments as compared to the other study species. Survival of button bush seedlings in the high/flooded treatment was high (87%), but root biomass of the survivors was reduced. Interspecific differences in growth, biomass, survivorship, and morphological characteristics existed among these swamp species to experimental conditions. These responses may help explain vegetation patterns in a thermally impacted swamp.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

Refer also to citation(s) 37595

5502 Biochemistry

Refer also to citation(s) 36832, 37150, 37331, 37521, 37647, 37653, 37672

37629 (DOE/ER/13359-4) **Mechanisms and control of K^+ transport in plants and fungi.** Slayman, C.L. Yale Univ., New Haven, CT (USA). Dept. of Cellular and Molecular Physiology. [1990]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER13359. Order Number DE90012900. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The overall purposes of this study are to provide a detailed functional description of active and passive potassium transport in model plant/fungal cells, to identify and isolate the protein molecules which mediate K+ transport, and ultimately to determine the intramolecular mechanisms which determine ion passage. The two major research lines now being followed are cloning three varieties of K+ transporters in Neurospora crassa, and characterizing potassium channels and proton pumps in Neurospora and Saccharomyces cerevisiae electrophysiologically, largely by means of patch recording.

37630 (DOE/ER/13731-3) **Structure and regulation of methanogen genes: Progress report, July 1, 1987–June 30, 1989.** Reeve, J.N. Ohio State Univ. Research Foundation, Columbus, OH (USA). Dept. of Microbiology. [1989]. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER13731. Order Number DE90012627. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Our goals are to determine the mechanisms of gene expression in archaebacterial methanogens and to use molecular biological approaches to investigate methanogenesis. At the outset nothing was known and the basic information gained, detailing the structure, organization and evolutionary relationships of housekeeping genes in methanogens was therefore very important. Now having cloned the operons from several archaebacterial methanogens we can determine if and how transcription of the reductase and hydrogenase genes is regulated in vivo using the protocols we have established to label, isolate and quantitate messenger-RNA (mRNAs) synthesized in vivo by methanogens. We have gained experience and expertise in anaerobic enzymology. A complete structure-function description of a methanogen promoter has yet to be completed but is within experimental sight. We have the very strong mcr and mvh (gene) promoters, site-specific mutagenesis and should soon have RNA-polymerase (RNAP) preparations that initiate transcription accurately in vitro available to proceed with this project.

37631 (DOE/ER/13794-1) **Cellulase: A key enzyme for fermentation feedstocks: Progress report, September 1, 1987–August 31, 1988.** Eveleigh, D.E. Rutgers–the State Univ., New Brunswick, NJ (USA). Dept. of Biochemistry and Microbiology. Aug 1988. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER13794. Order Number DE90012805. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Biomass can be fermented to a range of useful products. For efficiency a well characterized and effective cellulase is necessary to gain fermentable sugars from cellulosics. Microbial cellulase systems are comprised of multiple components namely, endoglucanase (EG), cellobiohydrolase (CBH), and beta-glucosidase, which act synergistically. We have been clarifying the cellulase system especially that of Microbispora bispora through isolation of the individual components. As there is no direct assay for the cellobiohydrolase component, we have made monoclonal antibodies to them, and are using them to characterize the cellobiohydrolases of Trichoderma reesei and M. bispora. With T. reesei, rapid purification has been achieved through MAb affinity chromatography and also a highly sensitive MAb assay for CBH in crude cellulase broths has been developed. for M. bispora, the monoclonal antibodies towards CBH have been prepared and are being used for selection of clones from a M. bispora gene library. We have focused on the M. bispora cellulase.

37632 (DOE/ER/13794-2) **Cellulase: A key enzyme for fermentation stocks: Final report, 1987–1989.** Eveleigh, D.E.; Macmillan, J.D. Rutgers–the State Univ., New Brunswick, NJ (USA). Dept. of Biochemistry and Microbiology. 3 Jul 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER13794. Order Number DE90012806. Available from NTIS, PC A03/MF A01 - OSTI.

A thermophilic actinomycete Microbispora bispora was selected from many thermophilic actinomycetes as it that gave good yields of a stable, cellulase and its β-glucosidase was resistant to end-product inhibition. The initial cloning of the cellobiase and cellobiohydrolase have been also accomplished. We now propose to further characterize the cellobiohydrolase and the cellobiase with the longer term objective of being able to predict optimal proportions of these components which will result in optimal cellulolysis, besides also the rationale design and genetic construction of a truly effective cellulolytic ethanologen, namely Zymomonas mobilis. This study was initiated with a further general goal of developing the application of monoclonal antibodies for studying cellulase. Monoclonal antibodies acting towards cellulases have proved most useful for developing a sensitive direct assay for cellobiohydrolase (Trichoderma reesesi) and for screening Escherichia Coli (E. coli) transformant clones containing Microbispora bispora cellobiohydrolase genes. All goals of the original proposal, characterization of the M. bispora cellulase, developing methods to gain secretion, and the application of monoclonal antibodies to screening and for affinity purification of cellobiohydrolase have been accomplished. 22 refs., 6 figs.

37633 (DOE/ER/13794-3) **Cellulase: A key enzyme for fermentation stocks: Progress report, 1989–1990.** Eveleigh, D.E.; Macmillan, J.D. Rutgers–the State Univ., New Brunswick, NJ (USA). Dept. of Biochemistry and Microbiology. 15 Mar 1990. 4p.

Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER13794. Order Number DE90012807. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A thermophilic actinomycete Microbispora bispora was selected from many thermophilic actinomycetes as it that gave good yields of a stable, cellulase and its β-glucosidase was resistant to end-product inhibition. The cellulase is comprised of endoglucanases, cellobiohydrolases and cellobiases that act synergistically. These components have been characterized to differing degrees. The initial cloning of the cellobiase and cellobiohydrolase have been also accomplished. We now propose to further characterize the cellobiohydrolase and the cellobiase with the longer term objective of being able to predict optimal proportions of these components which will result in optimal cellulolysis. The original goals of characterization of the M. bispora cellulase, developing methods to gain secretion, and the application of monoclonal antibodies to screening and for affinity purification of cellobiohydrolase have been accomplished.

37634 (DOE/ER/13995–T1) **The role of purine degradation in methane biosynthesis and energy production in Methanococcus vannielii: Progress report, March 1, 1989–February 28, 1990.** DeMoll, E. Kentucky Univ., Lexington, KY (USA). Dept. of Microbiology and Immunology. 30 Oct 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-89ER13995. Order Number DE90012442. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper contains the specific goals of this proposal and is a summary of the progress toward that specific goal. These goals include: survey of other methanogens to assess purine degradation, isolation and characterization of the enzyme and the products of the formiminoglycine cleavage reaction in methanococcus vannielii, ascertaining of the metabolic fate of glycine formed from the cleavage of formiminoglycine, and elucidation of the route by which the formyl moiety of formiminoglycine is incorporated into the methane biosynthetic pathway.

37635 (DOE/ER/60492–5) **Factors controlling decomposition in arctic tundra and related root mycorrhizal processes: [Progress report].** Linkins, A.E. Clarkson Univ., Potsdam, NY (USA). Dept. of Biology. [1990]. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER60492. Order Number DE90012249. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Work proposed for the final year of Phase 1 of the R&D Program will focus on three areas: (1) acquire soil and root-mycorrhizal process data which will incorporate baseline enzymatic and soil respiration data, as has been collected during the duration of the project, into the manipulations in the project initiated by Drs. Chapin and Schimmel. Additional enzymatic data on a broader range of organic nitrogen compound decomposition will be collected to better integrate existing decomposition data and modeling structure with the expanded information to be collected on nitrogen dynamics in soils and plant compartments. This activity will principally be done in the new dust disturbance experiment the overall project has planned. (2) Finalize data sets on the complete mineralization of cellulose, and cellulose like plant structural material, and cellulose intermediate hydrolysis products into CO2 and CH4 from soils from water track and non-water track soils and soils from riparian sedge moss meadow vegetation areas. Gas efflux from these soils will be measured in closed microcosms in which the soils will be manipulated to alter their redox state. (3) Continue developing and testing the GAS models on decomposition and plant growth and nutrient acquisition. The primary activity of this project will be on this latter task. 22 refs.

37636 (DOE/ER/60623–T2) **[Drug-DNA interactions studied by x-ray crystallography]: [Progress report].** Sobell, H.M. Rochester Univ., NY (USA). Dept. of Biophysics. [1990]. 26p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER60623. Order Number DE90013461. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The broad objectives of this research proposal are to understand how two different intercalators — actinomycin D and ethidium — bind to DNA. Both drugs are widely used in the molecular biology area, and providing a detailed understanding of their stereochemical interactions with DNA could lead to valuable new insights into DNA structure and function. With this in mind, we have crystallized two different complexed that contain these drug molecules complexed to DNA-like oligomers and are carrying out their crystallographic analyses. The specific aims of this research proposal are to solve and to refine these structures to the highest possible resolution. This will involve recollecting the intensity data using the synchrotron radiation source on larger crystals of both complexes that are now available. 65 refs., 12 figs.

37637 (LA–11803-PR) **Life Sciences Division and Center for Human Genome Studies Annual report 1989.** Spitzmiller, D.; Bradbury, M.; Cram, L.S. (comps.). Los Alamos National Lab., NM (USA). May 1990. 120p. Sponsored by U.S. Department of Agriculture; U.S. Department of Defense; U.S. DOE Energy Research; U.S. Department of the Interior; National Aeronautics and Space Administration; National Institute of Environmental Health Sciences. DOE Contract W-7405-ENG-36. Order Number DE900*2016. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report summarizes the research and development activities of Los Alamos National Laboratory's Life Sciences Division and biological aspects of the Center for Human Genome Studies for the calendar year 1989. Future editions will include all human genome research projects. The technical portion of the report is divided into two parts: selected research highlights, and project descriptions and accomplishments. Research highlights provide a more detailed description of a select set of projects. A technical description of all projects is presented in sufficient detail to permit the informed reader to assess their scope and significance. 2 figs.

37638 **Variable rRNA gene copies in extreme halobacteria.** Sanz, J.L. (Centro de Biologia Molecular, Madrid (Spain)); Marin, I.; Ramirez, L.; Amils, R.; Abad, J.P.; Smith, C.L. *Nucleic Acids Research (UK),* 16(16): 7827-7832 (25 Aug 1988).

Using PFG electrophoresis techniques, the authors have examined the organization of rRNA gene in halobacterium species. The results show that the organization of rRNA genes among closely related halobacteria is quite heterogeneous. This contrasts with the high degree of conservation of rRNA sequence. The possible mechanism of such rRNA gene amplification and its evolutionary implications are discussed.

37639 **Incision of damaged versus nondamaged DNA by the Escherichia coli UvrABC proteins.** Caron, P.R. (Johns Hopkins Univ. School of Hygiene and Public Health, Baltimore, MD (USA)); Grossman, L. *Nucleic Acids Research (UK),* 16(16): 7855-7865 (25 Aug 1988).

Incision of damaged DNA by the Escherichia coli UvrABC endonuclease requires the UvrA, UvrB, and UvrC proteins as well as ATP hydrolysis. This incision reaction can be divided into three steps: site recognition, preincision complex formation, and incision. UvrAB is able to execute the first two steps in the reaction while the addition of UvrC is required for the incision of DNA. This incision reaction does not require ATP hydrolysis and results in the formation of a tight UvrABC post-incision complex and the generation of an oligomer of approximately 12 nucleotides. At high UvrABC concentrations the specificity of the incision for damaged DNA is decreased and significant incision of undamaged DNA occurs. Analogous to damage specific incision, this type of incision leads to generation of an oligonucleotide, but in this case the size is approximately 9 nucleotides in length. Further evidence shows that the combination of UvrB and UvrC proteins can generate a significant amount of a similar size product on undamaged DNA. In addition, the UvrC protein alone can generate a small amount of the same product. Immunological characterization of the weak nuclease activity seen with UvrC indicates that the activity is very tightly associated with the purified UvrC protein.

5503 Cytology

37640 (LA-UR–90-1568) **A CLIPS expert system for clinical flow cytometry data analysis.** Salzman, G.C. (Los Alamos National Lab., NM (USA)); Duque, R.E.; Braylan, R.C.; Stewart, C.C. Los Alamos National Lab., NM (USA). [1990]. 6p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-9008107–1: 1. annual user's group, Houston, TX

(USA), 16-19 Aug 1990). Order Number DE90012098. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

An expert system is being developed using CLIPS to assist clinicians in the analysis of multivariate flow cytometry data from cancer patients. Cluster analysis is used to find subpopulations representing various cell types in multiple datasets each consisting of four to five measurements on each of 5000 cells. CLIPS facts are derived from results of the clustering. CLIPS rules are based on the expertise of Drs. Stewart, Duque, and Braylan. The rules incorporate certainty factors based on case histories.

5504 Genetics

Refer also to citation(s) 36819, 37630, 37637, 37671

37641 Highly polymorphic locus D15S24 (CMW-1) maps to 15pter-q13. [HGM9 provisional no. D15S24]. Rich, D.C. (Baylor College of Medicine, Houston, TX (USA)); Summers, K.M.; van Tuinen, P.; Ledbetter, D.H.; Witkowski, C.M. *Nucleic Acids Research (UK)*, 16(17): 8740 (12 Sep 1988).

CMW-1, containing a 3.8 kb Eco RI fragment, was isolated from a flow sorted library cloned in Charon 21A from the Los Alamos National Laboratory (LA15NS02). The 3.8 kb fragment has also been inserted into the Eco RI site of pUC18. D15S24 maps to chromosome 15, region 15pter-q13, using a somatic cell hybrid regional mapping panel. Co-dominant segregation was shown for alleles detected with Eco RI and Taq I in two informative Caucasian families totaling 17 individuals. Coordinate variation using multiple enzymes suggests that CMW-1 detects a variable number of tandem repeats.

5505 Metabolism

Refer also to citation(s) 37626

37642 Leaf magnesium alters photosynthetic response of low water potentials in sunflower. Rao, I.M. (Univ. of Illinois, Urbana (USA)); Sharp, R.E.; Boyer, J.S. *Plant Physiology (USA)*, 84(4): 1214-1219 (Aug 1987). DOE Contract FG05-84ER13273.

We grew sunflower (Helianthus annuus L.) plants in nutrient solutions having nutritionally adequate but low or high Mg^{2+} concentrations and determined whether photosynthesis was effected as leaf water potentials (ψ_w) decreased. Leaf Mg contents were 3- to 4-fold higher in the plants grown in high Mg^{2+} concentrations (10 millimolar) than in those grown in low concentrations (0.25 millimolar). These contents were sufficient to support maximum growth, plant dry weight, and photosynthesis, and the plants appeared normal. As low ψ_w developed, photosynthesis was inhibited but more so in high Mg leaves than in low Mg leaves. The effect was particularly apparent under conditions of light- and CO_2-saturation, indicating that the chloroplast capacity to fix CO_2 was altered. The differential inhibition observed in leaves of differing Mg contents was not observed in leaves having differing K contents, suggesting that the effect may have been specific for Mg. Because Mg^{2+} inhibits photophosphorylation and coupling factor activities at concentrations likely to occur as leaves dehydrate, Mg may play a role in the inhibition of chloroplast reactions at low ψ_w, especially in leaves such as sunflower that markedly decrease in water content as ψ_w decreases.

5506 Medicine

Refer also to citation(s) 37669, 37938

37643 (DOE/ER/60763–1) **Positron Emission Tomography (PET): Final report, January 15, 1989–January 14, 1990.** Welch, M.J. Washington Univ., St. Louis, MO (USA). School of Medicine. Jan 1990. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-89ER60763. Order Number DE90012491. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Positron emission tomography (PET) assesses biochemical processes in the living subject, producing images of function rather than form. Using PET, physicians are able to obtain not the anatomical information provided by other medical imaging techniques, but pictures of physiological activity. In metaphoric terms, traditional imaging methods supply a map of the body's roadways, its, anatomy; PET shows the traffic along those paths, its biochemistry. This document discusses the principles of PET, the radiopharmaceuticals in PET, PET research, clinical applications of PET, the cost of PET, training of individuals for PET, the role of the United States Department of Energy in PET, and the futures of PET. 22 figs.

37644 (DOE/ER/60872–1) **An accelerator neutron source for BNCT [Boron Neutron Capture Therapy]: Progress report, 15 July 1989–15 March 1990.** Blue, T.E. Ohio State Univ., Columbus, OH (USA). Dept. of Mechanical Engineering. Mar 1990. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-89ER60872. Order Number DE90012494. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The objectives of this proposal are twofold. One objective is to design and test (using the OSU Van de Graaff accelerator) a moderator assembly for a thermal neutron source for the treatment of superficial tumors by Boron Neutron Capture Therapy (BNCT). We will identify the current of 2.5 MeV protons which is necessary to treat a patient in less than one hour. Our second objective is to design and thermally test a target for our thermal and epithermal source of neutrons for BNCT. Our work to date in fulfilling these project goals is described in this document. 11 refs., 4 figs., 1 tab.

37645 (DOE/ER/60894–1) **SPECT [single photon emission computed tomography] assay of radiolabeled monoclonal antibodies: Progress report, September 1989–April 1990.** Jaszczak, R.J. Duke Univ. Medical Center, Durham, NC (USA). Dept. of Radiology. Apr 1990. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-89ER60894. Order Number DE90012438. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The accurate determination of the biodistribution of radiolabeled monoclonal antibodies (MoAbs) is important for calculation of dosimetry and evaluation of pharmacokinetic variables such as antibody dose and route of administration. A major long-term objective of this proposal is to determine the utility of single photon emission computed tomography (SPECT) for quantifying the biodistribution of monoclonal antibodies labeled with the clinically relevant radionuclides iodine-123 (I-123) and indium-111 (In-111). The specific aims of this project include the comparison of the effects of three methods of radiolabeling anticarcinoembryonic antigen (CEA-110) — iodination by Iodogen, the tin-containing ester methods and an indium chelate method — on the immunoreactivity and affinity of the antibody. The biodistribution of anti-CEA labeled by the three methods will be compared in tumor bearing and normal mice. Subsequent studies of the pharmacokinetics of I-123 and In-111 labeled anti-CEA will be determined by SPECT in non-human primates. The errors associated with the SPECT measurements will be assessed with Monte Carlo simulations and by scanning phantoms containing I-123 or In-111 activity in regions of uniform and nonuniform attenuation. The ability of SPECT to quantify I-123 and In-111 distributions will be assessed, and new acquisition geometries and reconstruction algorithms for improved quantification will be evaluated. 8 figs., 4 tabs.

37646 (DOE/ER/60899–2) **One step Tc-99m labeling of antibodies for use in inflammation imaging.** Rhodes, B.A.; Marek, M.J.; Tuchsen, D.; Budd, P. RhoMed, Inc., Albuquerque, NM (USA). 16 Apr 1990. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract FG04-89ER60899. Grant 1 R43 CA50788-01. (CONF-9003170–1: High country nuclear medicine meeting, Vail, CO (USA), 12-17 Mar 1990). Order Number DE90012426. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Two related antibody radiopharmaceutical kits for imaging inflammation have been developed using a one step Tc-99m radiolabeling procedure. Labeling of antibodies with Tc-99m is accomplished by addition of Sodium Pertechnetate, USP, and a brief room temperature incubation. The procedure was modified by: a process purification step; optimizing the amount of protein to be labeled and the amount of stannous salts need for reduction of the pertechnetate; and optimizing the stabilizing agent. With these modifications, it has been possible to achieve 100% yields of strongly bonded Tc-99m as determined by quantitative HPLC. Blood clearance of Tc-99m in rats has been measured in parallel to

the I-125 labeled analog. The immunoreactive fraction of Tc-99m labeled monoclonal antibody 480 has been measured using both human granulocyte and solid phase antigen binding and found equal or better than that obtained using other labeling methods. The Tc-99m bound to the antibody has been correlated with free sulfhydryl formation and is not removed by transchelation using challenge agents. 5 refs., 9 figs.

37647 (DOE/ER/60899-3) **Improved method for the direct labeling of antibodies with Tc-99m.** Rhodes, B.A. (RhoMed, Inc., Albuquerque, NM (USA)); Hawkins, E.; Budd, P.; Deleide, G.; Seccamani, E.; Bonino, C. RhoMed, Inc., Albuquerque, NM (USA). 1990. 17p. Sponsored by U.S. DOE Energy Research; U.S. Department of Health and Human Services. DOE Contract FG04-89ER60899. Grant 1 R43 CA50788-01. (CONF-9003169–1: 5. international conference on monoclonal antibody immunocojugates for cancer, San Diego, CA (USA), 15-17 Mar 1990). Order Number DE90012425. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Antibodies and antibody fragments have been treated with stannous chloride or organic reducing agents to reduce disulfide bonds, providing sulfhydryl groups for binding reduced Tc-99m. The reduced antibody, additives and stannous salts are lyophilized. To radiolabel, sodium pertechnetate solution is added, which dissolves the protein and other reagents. The pertechnetate is reduced by the stannous ions and becomes bound to the antibody. After radiolabeling the shelf-life of the product exceeds the half-life of the radionuclide. One of the more effective additives is human serum albumin, which serves as a carrier protein, agent to protect against autoradiolysis and possibly as a transfer ligand. Many different antibodies have been labeled using this method. The most widely studied antibody is an anti-melanoma fragment which has now been used clinically in more than 1000 cases and has been proven effective for the diagnostic localization of melanoma. In summary, a single vial, one step procedure for the direct labeling of antibodies in the presence of human serum albumin has been developed, extensively characterized, and clinically validated. The method is used with murine monoclonal IgG fragments, IgM and human gamma globulin. 4 refs., 10 figs.

37648 (LUEDW-MED-OK–1010-1-40-1989) **Management and prognosis of patients with high-grade soft tissue sarcomas: An evaluation of a Scandinavian joint care program.** Alvegaard, T.A. Lund Univ. (Sweden). Dept. of Oncology. 16 Dec 1989. 47p. Order Number DE90631347. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Doxorubicin is one of the most active single agents in metastatic soft tissue sarcoma. This was the rationale for the evaluation og doxorubicin in an adjuvant situation for patients with high-grade soft tissue sarcoma in a randomized, Scandinavian, multicenter joint care program, which was carried out from January 1981 to February 1986, and included 240 patients. These patients comprised the base series for the investigations of the importance of the surgical margin and radiotherapy for local tumor control; the accuracy of malignancy grading and tumor typing; prognostic factors, including DNA content; and epidemiologic risk factors. The results showed that the use of doxorubicin as adjuvant chemotherapy did not have clinical benefit in patients with high-grade soft tissue sarcoma. The overall local tumor control was high (94 %) for radically operated on extremity-located tumors due to strict classification of surgical margins. The only risk factor for local recurrence was marginal surgery without radiotherapy with a four times higher risk than after compartmental or wide surgery. Twelve percent of the operations reported as radical were classified as marginal, demonstrating the importance of reevaluation of surgical margins, and in these patients the local recurrence rate was 37 %. The 5-year metastasis-free survival for the whole patients series was 55 %, with the extremes 79 % for the patients with no or only one risk factor and 0 % for those with four or five risk factors. The five prognostic factors found could be used for selection of high-risk patients for adjuvant chemotherapy in the future. The epidemiologic study gave limited support for an association between occupational phenoxy-acid exposure and soft tissue sarcoma development. (98 refs.).

37649 (NAC-AR–88-01, pp. 107-119) **Biophysical sciences: Physical characteristics of the neutron therapy unit.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

The neutron therapy system consists of an isocentric gantry capable of $\pm$ 185 degrees rotation. Field sizes of between 5 x 5 cm^2 and 30 x 30 cm^2 are defined by a rotatable continuously variable collimator. Neutrons are produced by the p(66 MeV)/Be(40 MeV) reaction. Basic neutron beam data were initially measured in order to provide sufficient information for radiobiological experiments to be undertaken. Some of these experiments indicated a differential in the biological effectiveness of the beam at the surface and at depth in a phantom. In order to reduce this differential at 2.5 cm thick polyethylene beam-hardening filter has been mounted in the treatment head. In addition beam-flattening filters are now also being used to flatten the beam profiles at depth in phantom. Measurements of the characteristics of the beam with the new configuration are still in progress. 12 figs., 6 refs.

37650 (NAC-AR–88-01, pp. 158-165) **The Pretoria cyclotron facility: Radiation physics.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

The past year has been devoted entirely to the evaluation of lineal energy spectra measured in the d(16) and p(66) fast neutron beams generated at Pretoria and Faure. An intercomparison study revealed good agreement with microdosimetric parameters determined at similar centres. The proportional counter measurements were futher exploited to evaluate the photon fraction in the mixed n/γ radiation fields. A microdosimetric assessment of beam quality was of particular value in determinig the optimum thickness of a beam-hardening filter for the p(66) therapy beam. 6 figs., 11 refs., 4 tabs.

37651 (NAC-AR–89-01, pp. 141-166) **Radiotherapy and research in the biophysical sciences: Radiotherapy.** National Accelerator Centre, Faure (South Africa). 1989. In *Annual report June 1989.* Available from the National Accelerator Centre, PO Box 72, Faure, 7131, South Africa.

Routine patient treatment commenced on the p(66 MeV)/Be isocentric neutron therapy facility on 21 February 1989. Several problems have occurred with the treatment unit, resulting in some delays in the dosimetry measurements and patient treatments. Extensive physical calibrations of the beam were completed following the installation of both flattening and hardening filters. A wide range of research projects have been undertaken on the neutron therapy unit. The first dosimetry measurements have been made in a 200 MeV proton beam. 26 figs., 4 tabs., 7 refs.

37652 (ORNL/FTR–2956) **[Radiopharmaceutical chemistry]: Foreign trip report, June 28–July 9, 1988.** Srivastava, P.C. Oak Ridge National Lab., TN (USA). 25 Jul 1988. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012379. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the Seventh International Symposium on Radiopharmaceutical Chemistry in Groningen, The Netherlands, where he presented two papers describing studies on "Radioiodinated Maleimides for Labeling Monoclonal Antibodies," and studies on "Nucleoside Probes for Tumor Diagnosis" which are currently being pursued by the traveler at the Oak Ridge National Laboratory (ORNL). The Radiopharmaceutical Symposium has been held every even year since 1976 and attracts participation from the international scientific community related to radiopharmaceutical development. The meeting in Groningen was attended by 350 participants from 22 countries, and 213 papers dealing mainly with the radiopharmaceuticals of technetium, heavy halogens, and cyclotron-produced radionuclides were presented. The traveler also visited the Cyclotron Center and the Organic Chemistry Department, Sart-Tilman University, Liege, Belgium, to evaluate the possibility of developing new collaborative projects. During this trip, the traveler had the opportunity to make contacts and have discussions with the scientists from industries, universities, and research institutions. New collaborative projects may be initiated as a result of these discussions.

37653 (UCRL-JC–103998) **Accelerator mass spectrometry in the biomedical sciences: Applications in low-exposure biomedical and environmental dosimetry.** Felton, J.S.; Turteltaub, K.W.; Vogel, J.S.; Balhorn, R.; Gledhill, B.L.; Southon, J.R.; Caffee, M.W.; Finkel, R.C.; Nelson, D.E.; Proctor, I.D. Lawrence Livermore National Lab., CA (USA). 10 May 1990. 25p. Sponsored by Natural Sciences and Engineering Research Council of Canada; U.S. DOE Defense Programs; National Cancer Institute; National Institute of Environmental Health Sciences. DOE Contract W-7405-ENG-48. 222Y-01-ES-70158 CA40811. Order Number DE90012989. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We are utilizing Accelerator Mass Spectrometry (AMS) as a sensitive detector for tracking the disposition of radio-isotope labeled molecules in the biomedical sciences. These applications have shown the effectiveness of AMS as a tool to quantify biologically important molecules at extremely low levels. For example, AMS is being used to determine the amount of carcinogen covalently bound to animal DNA (DNA adduct) at levels relevent to human exposure. Studies have been undertaken in our laboratory utilizing heterocyclic amine food-borne carcinogens and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), a potent environmental carcinogen, to study the metabolism of carcinogens at low doses. In addition, AMS is being used to detect the presence of rare proteins (mutant forms of protamine) in human sperm. Problems in the life sciences where detection sensitivity or sample sizes are limitations should also benefit from AMS. Studies are underway to measure the molecular targeting of cancer chemotherapeutics in human tissue and to pursue applications for receptor biology. We are also applying other candidate isotopes, such as ^{3}H (double labeling with ^{14}C) and ^{41}Ca (bone absorption) to problems in biology. The results described here with ^{14}C-labeled molecules coupled with new isotope applications clearly show AMS technology to be an important new tool for the biomedical sciences community. 29 refs., 5 figs., 2 tabs.

37654 **PET imaging: An overview and instrumentation.** Daghighian, F. (UCLA School of Medicine, Los Angeles, CA (USA)); Sumida, R.; Phelps, M.E. *Journal of Nuclear Medicine Technology (USA),* 18(1): 5-15 (Mar 1990). DOE Contract AC03-76SF00012.

This is the first article of a four-part series on positron emission tomography (PET). Upon completing the article, the reader should be able to: (1) comprehend the basic principles of PET; (2) explain various technical aspects; and (3) identify radiopharmaceuticals used in PET imaging.

5507 Microbiology

Refer also to citation(s) 36694, 36700, 36701, 36702, 36723, 36726, 36819, 37630, 37634

5509 Pathology

37655 (CONF-8907193–1) **Free-living amoebae: Health concerns in the indoor environment.** Tyndall, R.L.; Ironside, K.S. Oak Ridge National Lab., TN (USA). [1990]. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From ASTM conference on bioaerosols in the indoor environment; Boulder, CO (USA); 18-21 Jul 1989. Order Number DE90012167. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Free-living amoebae are the most likely protozoa implicated in health concerns of the indoor environment. These amoebae can be the source of allergic reactions, eye infections or, on rare occasions, encephalitis. While too large to be effectively aerosolized, free- living amoebae can support the multiplication of pathogens such as Legionella which are easily aerosolized and infectious via the pulmonary route. Traditional detection methods for free-living amoebae are laborious and time consuming. Newer techniques for rapidly detecting and quantitating free-living amoebae such as monoclonal antibodies, flow cytometry, gene probes, and laser optics have or could be employed. 25 refs.

5510 Physiological Systems

37656 **Ontogenetic patterns of CO_2 exchange of Quercus rubra L. leaves during three flushes of shoot growth I. median flush leaves.** Hanson, P.J. (Oak Ridge National Lab., TN (USA)); Isebrands, J.G.; Dickson, R.E.; Dixon, R.K. *Forest Science (USA),* 34(1): 55-68 (Mar 1988). DOE Contract AC05-84OR21400.

Oak (Quercus) seedlings exhibit a pattern of shoot growth known to place demands on carbohydrate and nutrient reserves. This study was designed to determine ontogenetic patterns in CO_2 exchanges properties of red oak leaves, and to determine if individual leaf CO_2 exchange rates (CER) increase in response to the assimilate demand placed on a seedling during flushing. Northern red oak (Q. rubra L.) seedlings were grown in environments favorable for multiple flushes of shoot growth. Measurements of CER on single, attached, median leaves from each flush were made over a range of photosynthetic photon flux densities on plants at nine stages of seedling development through three flushes of growth. Carbon dioxide exchange rate of red oak leaves increased during leaf development up to and beyond full leaf expansion before decreasing an unusual pattern of photosynthesis during leaf ontogeny. Furthermore, first- and second-flush leaf CER initially decreased and then increased in conjunction with the third flush of shoot growth. These patterns indicate that red oak leaves have a capacity for CER adjustment in response to increase sink demand.

37657 **Ontogenetic patterns of CO_2 exchange of Quercus rubra L. leaves during three flushes of shoot growth II. Insertion gradients of leaf photosynthesis.** Hanson, P.J. (Oak Ridge National Lab., TN (USA)); Isebrands, J.G.; Dickson, R.E.; Dixon, R.K. *Forest Science (USA),* 34(1): 69-76 (Mar 1988). DOE Contract AC05-84OR21400.

Carbon dioxide exchange rates (CERs) of all leaves along the stem of northern red oak (Quercus rubra L.) seedlings (a leaf insertion gradient of profile) were determined at several stages of ontogeny. Seedlings were grown and measured under growth chamber conditions favorable for the production of multiple flushes of shoot growth. The CERs were measured with a portable closed-circuit CO_2 analyzer at ambient photosynthetic photon flux densities and were determined for every leaf of each seedling. Carbon dioxide exchange rates per unit projected area of individual leaves (CERA) increased along leaf-maturation gradients in expanding flushes. After flush growth was completed, all leaves of a flush has similar CERA. However, because median flush leaves were the largest, they accounted for the greatest proportion of an expanded-flush's CER. First-flush leaves were the major contributors to total seedling CER through the second flush of growth-encompassing half of the period required to produce a three-flush oak seedling. This study's data, based on short-term CER measurements, showed ontogenetic pattern of CO_2 exchange similar to those reported for northern red oak under steady state laboratory conditions.

5520 Public Health

Refer also to citation(s) 37563

5530 Agriculture and Food Technology

Refer also to citation(s) 37601

37658 (DOE/ER/60255–6) **Herbivore responses to plants grown in enriched carbon dioxide atmospheres: Progress report.** Lincoln, D.E. South Carolina Univ., Columbia, SC (USA). Dept. of Biological Sciences. May 1990. 86p. Sponsored by U.S. DOE Energy Research. DOE Contract FG09-84ER60255. Order Number DE90012221. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Our initial study of sagebrush and grasshopper responses to elevated and historical carbon dioxide atmospheres is complete and has been accepted for publication. The study on Biomass Allocation Patterns of Defoliated Sagebrush Grown Under Two Levels of Carbon Dioxide has completed and the manuscript has been submitted for publication. We have completed the study of plant growth under two nutrient and carbon dioxide regimes and

grasshopper feeding responses. The study of a specialist feeding caterpillar, the cabbage butterfly, and a mustard hostplant has recently been completed. We were able to identify the principal allelochemicals of the mustard plants, butenyl and pentenyl isothiocyanates, by combined gas chromatography and mass spectrometry. Measurement of these chemicals has been a critical component of this study since these compounds contain nitrogen and sulphur and act as a feeding stimulant to the caterpillar. This insect responds to elevated carbon dioxide by consuming more leaves and we can now say that this is not due to a change in the feeding stimulants. Reduced leaf protein content is a critical factor for even specialist feeding insect herbivores under elevated carbon dioxide conditions. The study on Grasshopper Population Responses to Enriched Carbon Dioxide Concentration is currently in progress at the Duke University Phytotron. We have changed hostplant species in order to complement the investigations of carbon dioxide effects on tallgrass prairie. Specifically, we are using big bluestem, Andropogon geradii, as the host plant to feed to the grasshoppers. This experiment will be completed in July 1990.

37659 (IAEA-TECDOC–544) **Factors affecting practical application of food irradiation: Proceedings of an advisory group meeting held in Vienna, 27 June - 1 July 1988.** International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Apr 1990. 88p. (CONF-8806477–: Advisory group meeting on commercial use of food irradiation, Vienna (Australia), 27 Jun 1988). Order Number DE90631277. Available from NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

FAO and IAEA convened an Advisory Group Meeting on Commercial Use of Food Irradiation in order to discuss problems of the industry's acceptance of food irradiation and their remedies. Senior executives from major food industries, trade and consumer organizations were invited to discuss these problems and to prepare a report which would serve as the basis for future plan of action by sponsoring Organizations in the field of food irradiation. This publication contains the report of the meeting, papers presented by the participants and their recommendations to the sponsoring Organizations. Refs and tabs.

37660 (NIRS-RSD–85) **Radioactivity survey data in Japan, part 2: Dietary materials.** National Inst. of Radiological Sciences, Chiba (Japan). Apr 1989. 30p. Order Number DE90798892. Available from NTIS (US Sales Only), PC A03/MF A01.

The report presents data obtained through a radioactivity survey. Various environmental and dietary materials are collected for analysis. Rain and dry fallout are collected monthly. Airborne dust is collected every three months. Service water samples are taken semiyearly. Freshwater is taken once a year (fishing season). Soil samples are taken once a year from two layers at different depths. Sea water is collected once a year at fixed stations where the effect of terrestrial fresh water from rivers is expected to be negligibly small. Sea sediments are collected once a year in the same area as that for the sea water sample. A full one day ordinary diet including three meals, water and tea for five persons is collected semiyearly as a sample of 'total diet'. Polished rice is collected in producing districts and in consuming areas. Raw milk is collected in producing districts and commercial milk is purchased in consuming districts. Vegetable are collected once a year in producing and consuming districts. Tea samples are also collected once a year. Fish, shellfish and seaweeds are collected once a year. Test solutions are prepared from these samples. Strontium-90 and cesium-137 are separated and subjected to quantitative determination. Results obtained are tabulated. This part (Part 2) presents data on dietary materials. (N.K.).

37661 (NIRS-RSD–87) **Radioactivity survey data in Japan, part 2: Dietary materials.** National Inst. of Radiological Sciences, Chiba (Japan). Oct 1989. 38p. Order Number DE90798894. Available from NTIS (US Sales Only), PC A03/MF A01.

The report presents data obtained through a radioactivity survey. Various environmental and dietary materials are collected for analysis. Rain and dry fallout are collected monthly. Airborne dust is collected every three months. Service water samples are taken semiyearly. Freshwater is taken once a year (fishing season). Soil samples are taken once a year from two layers at different depths. Sea water is collected once a year at fixed stations where the effect of terrestrial fresh water from rivers is expected to be negligibly small. Sea sediments are collected once a year in the same area as that for the sea water sample. A full one day ordinary diet including three meals, water and tea for five persons is collected semiyearly as a sample of 'total diet'. Polished rice is collected in producing districts and in consuming areas. Raw milk is collected in producing districts and commercial milk is purchased in consuming districts. Vegetable are collected once a year in producing and consuming districts. Tea samples are also collected once a year. Fish, shellfish and seaweeds are collected once a year. Test solutions are prepared from these samples. Strontium-90 and cesium-137 are separated and subjected to quantitative determination. Results obtained are tabulated. This part (Part 2) presents data on dietary materials. (N.K.).

37662 **DOE uses transportable irradiator for demonstration and testing.** *Food Technology (USA),* 42(12): 126 (Dec 1988).

The U.S. Dept. of Energy's Pacific Northwest Laboratory (PNL), Richland, Washington (operated by Battelle Memorial Institute), has a transportable irradiator that was built to travel to various locations to demonstrate the benefits of low-dose irradiation for the processing of food. Part of a DOE program designed to establish irradiation facilities in Alaska, Florida, Hawaii, Iowa, Oklahoma, and Washington, the mobile unit can also be used for research, pilot-scale processing, operator training, and education. The irradiation unit consists of two lead-lined cylindrical chambers-an irradiation chamber and a source chamber-inside a steel casing. During operation, the item to be irradiated is placed inside the irradiation chamber, which is then rotated until a window in the chamber lines up with a screened window in the source chamber. The source chamber contains the transportation cask containing the four capsules of cesium-137 that are used as the source of gamma radiation. During operation, the lid of the cask is raised, pulling the capsules into operating position. In this alignment, the product is irradiated for a predetermined length of time. Then the lid of the cask is lowered and the irradiation chamber is rotated back to its original position for removal of the product.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

Refer also to citation(s) 36803, 36972, 37562, 37574, 37575, 37576, 37596, 37620, 37623, 37645, 37938

37663 (BNL–44646) **Testing methodologies.** Bender, M.A. Brookhaven National Lab., Upton, NY (USA). [1990]. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-9005220–1: Community health study for a low-level radioactive waste disposal site, Syracuse, NY (USA), 11-12 May 1990). Order Number DE90012229. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Several methodologies are available for screening human populations for exposure to ionizing radiation. Of these, aberration frequency determined in peripheral blood lymphocytes is the best developed. Individual exposures to large doses can easily be quantitated, and population exposures to occupational levels can be detected. However, determination of exposures to the very low doses anticipated from a low-level radioactive waste disposal site is more problematical. Aberrations occur spontaneously, without known cause. Exposure to radiation induces no new or novel types, but only increases their frequency. The limitations of chromosomal aberration dosimetry for detecting low level radiation exposures lie mainly in the statistical "signal to noise" problem, the distribution of aberrations among cells and among individuals, and the possible induction of aberrations by other environmental occupational or medical exposures. However, certain features of the human peripheral lymphocyte-chromosomal aberration system make it useful in screening for certain types of exposures. Future technical developments may make chromosomal aberration dosimetry more useful for low-level radiation exposures. Other

methods, measuring gene mutations or even minute changes on the DNA level, while presently less will developed techniques, may eventually become even more practical and sensitive assays for human radiation exposure. 15 refs.

37664 (CNIC–00263) **Isolation and radioprotective assays of tissue inhibitory factors.** Geng Yongjian (Suzhou Medical Coll., JS (China)); Lu Zhaoyang; Yin Zhiwei; Feng Shuyi; Mao Zijun. China Nuclear Information Centre, Beijing, BJ (China). 1989. 7p. (In Chinese). (SMC–0027). Order Number DE90631225. Available from NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Two inhibtory substance were isolated from the calf spleens and the porcine blood, which were respectively designated to as Granulopoiesis Inhibitory Factor (GIF) and Plasma Nonspecific Immunosuppressive Protein (PNIP). The biological activith of GIF and PNIP was examined. GIF could remarkably inhibit GM-CFU of the BaBL/C mouse bone marrow cells but had no effect on the ^{3}H-TdR incorporation into the mouse spleen cells and mouse lymphoma L5178Y cells. PNIP could significantly suppress the proliferation of the lymphocytes from human peripheral blood and C57BL/6J mouse spleen and the malignant lymphoid cells, L5178Y cells and Raji cells, but had no effect on Hela cells and Vero-E6 cells which are nonlymphoid cell. GIF and PNIP could also result in the decline of the radiosensitivity of their responsive target cells to ^{60}Co Gamma rays. When the GIF-treated mouse bone marrow cells were irradiated, the number of their GM-CFU was much more than that of the control. The survival rate and the ^{3}H-TdR incorporational rate of the L5178Y cells which were exposure to PNIP and then were irradiated was higher than that of the control. The radioprotective activity of the tissue inhibitory factors was closely related to the time of acting on the target cells, the concentration of them and the doses of irradiation.

37665 (DOE/ER/60903–1) **Activation of oncogenes by radon progeny and x-rays.** Ling, C.C. Sloan-Kettering Inst. for Cancer Reserch, New York, NY (USA). Dept. of Medical Physics. 1990. 23p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-89ER60903. Order Number DE90013013. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The overall goal of this proposal is to study the carcinogenic effect of both high and low LET radiation at the molecular level, utilizing techniques developed in molecular biology, cancer cell biology and radiation biology. The underlying assumption is that malignant transformation of normal cells is a multistep process requiring two or more molecular events in the genomic DNA. These events are most likely the activation of proto-oncogenes, or the inactivation of tumor suppressor genes. We hypothesize that radiation may induce such events in one or more steps of the multistep process. We will use in vitro models of transformation that reproduce the stepwise progression of normal cells towards the transformed phenotype and ask whether radiation can provide the necessary activating function at discrete steps along this path. Our strategy involves transfecting into normal primary cells a variety of cloned oncogenes that are known to supply only some of the functions necessary for full transformation. These "partially transformed" cells will be the targets for irradiation by x-rays and alpha particles. The results will provide the basis for assessing the ability of ionizing radiation to activate oncogenic functions that "complement" the oncogene already present in the transfected ells and produce the fully transformed phenotype. 121 refs.

37666 (EGG-BNCT–8777-Vol.4-No.2) **Power Burst Facility/ Boron Neutron Capture Therapy Program for Cancer Treatment: Monthly bulletin, Volume 4, No. 2.** Ackermann, A.L. (ed.); Dorn, R.V. III. EG and G Idaho, Inc., Idaho Falls, ID (USA). Feb 1990. 26p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE90013094. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Highlights of the PBF/BNCT Program during February 1990 include progress within the areas of: Gross Boron Analysis in Tissue, Blood, and Urine, Analytical Methodologies Development for BSH (Borocaptate Sodium) Purity Determination, Noninvasive Boron Quantitative Determination, Dosimetry, Analytical Radiation Transport and Interaction Modeling, Large Animal Model Studies in that Ten dogs were irradiated to grossly bracket neutron beam only tissue tolerance limits, Neutron Source and Facility Preparation in that the PBF neutron filter and bismuth shielding design revisions, recommended during the preliminary design review, have been incorporated and Administration and Common Support. 1 tab.

37667 (EGG-ESQ–8808) **Internal dosimetry and control.** Rich, B.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). May 1990. 39p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE90012968. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This internal dosimetry and control report provides guidance for EG&G Idaho, Inc., field programs in detecting, evaluating, and controlling personnel exposure resulting from uptake of radionuclides by the body. Procedures specific to each program or facility are required to define the details of guidance from this report. Fundamental principles related to philosophy, policies, monitoring guidelines, and dose evaluation are discussed. Specific numerical guides and action levels are developed to guide the programs in evaluating the significance of specific analytical results. The requirement to thoroughly document the results and provide a formal technical base for each policy and/or practice is outlined and explained. 8 refs., 3 figs., 7 tabs.

37668 (NAC-AR–88-01, pp. 166-176) **The Pretoria cyclotron facility: Radiobiology.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

The ongoing radiobiology programme at the Pretoria Cyclotron has proved invaluable for the pre-clinical calibration measurements at the Faure neutron therapy facility. Using biological endpoints complementary to those employed by radiobiologists at Faure, RBE and OER studies were successfully completed. Of note was the radiobiological assessment of beam quality as a function of filtration. These measurements were decisive in optimizing the thickness of the hydrogenous filter. The evaluation of synergistic effects in mixed radiation fields has been extended to mammalian cells and has concentrated on biological responses in mixed fields of varying quality. 9 figs., 12 refs., 3 tabs.

37669 (NAC-AR–89-01, pp. 167-205) **Radiotherapy and research in the biophysical sciences: Biophysical research projects.** National Accelerator Centre, Faure (South Africa). 1989. In *Annual report June 1989.* Available from the National Accelerator Centre, PO Box 72, Faure, 7131, South Africa.

A wide range of research projects, predominantly of a radiobiological nature, has been undertaken on the neutron therapy facility by both NAC staff and outside users. Some projects were not undertaken at the NAC, but were undertaken by NAC staff at other institutes. These projects are of importance to the radiotherapy programme at the NAC in terms of understanding the molecular effects which radiation has on cells and in providing essential data relevant to neutron beam dosimetry and to the execution of clinical trials. 25 figs., 11 tabs., 54 refs.

37670 (ORNL/FTR–2851) **[Radiation protection]: Foreign trip report, April 8–16, 1988.** Swaja, R.E. Oak Ridge National Lab., TN (USA). 6 May 1988. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012352. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler attended the Seventh Congress of the International Radiation Protection Association (IRPA) in Sydney, Australia, April 11–15, 1988. This conference consisted of a comprehensive technical program with oral and poster presentations in all areas of radiation protection including several topics which were of special interest to the traveler; e.g., neutron dosimetry, personnel dosimetry and instrumentation, radiobiology, and radiation accidents. Besides attending technical sessions, the traveler presented a paper on results and implications of neutron personnel dosimetry intercomparison studies conducted since 1974 at the Oak Ridge National Laboratory (ORNL). During the meeting, the traveler discussed possible future collaborative research efforts with scientists from several countries and obtained commitments for an ORNL-coordinated radiation protection conference planned for November of 1988. Through the conference attendance and discussions with dosimetry researchers, the traveler gained information concerning

directions and philosophies in radiation protection and dosimetry and made preliminary plans for future cooperative efforts which will be directly related to Department of Energy (DOE) programs.

37671 (ORNL/FTR–3628) **[Biological effects of atomic radiation]: Foreign trip report, May 11–19, 1989.** Selby, P.B. Oak Ridge National Lab., TN (USA). 1 Jun 1990. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012106. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the thirty-ninth session of UNSCEAR, where he took part in the meetings of the Biological Subgroup and the Working Group of the full UNSCEAR Committee. He listened to the discussion of the many documents under preparation and provided advice on questions related to genetics. He was extensively involved in discussion of the document entitled "Hereditary effects of radiation." During the discussion of that document, he served as the rapporteur of the Biological Subgroup. Important contacts were made with many internationally prominent scientists involved in radiation protection and risk evaluation. Since mouse data, many of them collected in the ORNL Biology Division, form a major component of genetic risk estimation, the traveler was able to provide first-hand information and to play an active role in the deliberations.

5602 Thermal Effects

37672 Synthesis of the low molecular weight heat shock proteins in plants. Mansfield, M.A. (Univ., of Georgia, Athens (USA)); Key, J.L. *Plant Physiology (USA),* 84(4): 1007-1017 (Aug 1987). DOE Contract AS09-80ER10678.

Heat shock of living tissue induces the synthesis of a unique group of proteins, the heat shock proteins. In plants, the major group of heat shock proteins has a molecular mass of 15 to 25 kilodaltons. Accumulation to these proteins to stainable levels has been reported in only a few species. To examine accumulation of the low molecular weight heat shock proteins in a broader range of species, two-dimensional electrophoresis was used to resolve total protein from the following species: soybean (Glycine max L. Merr., var Wayne), pea (Pisum sativum L., var Early Alaska), sunflower (Helianthus annuus L.), wheat (Triticum asetivum L.), rice (Oryza sativa L., cv IR-36), maize (Zea mays L.), pearl millet (Pennisetum americanum L. Leeke, line 23DB), and Panicum miliaceum L. When identified by both silver staining and incorporation of radiolabel, a diverse array of low molecular weight heat shock proteins was synthesized in each of these species. These proteins accumulated to significant levels after three hours of heat shock but exhibited considerable heterogeneity in isoelectric point, molecular weight, stainability, and radiolabel incorporation. Although most appeared to be synthesized only during heat shock, some were detectable at low levels in control tissue. Compared to the monocots, a higher proportion of low molecular weight heat shock proteins was detectable in control tissues from dicots.

37673 High-temperature sensitivity and its acclimation for photosynthetic electron reactions of desert succulents. Chetti, M.B. (Univ. of California, Los Angeles (USA)); Nobel, P.S. *Plant Physiology (USA),* 84(4): 1063-1067 (Aug 1987). DOE Contract AC03-76SF00012.

Photosynthetic electron reactions of succulent plants from hot deserts are able to tolerate extremely high temperatures and to acclimate to seasonal increase in temperature. In this study, we report the influence of relatively long, in vivo, high-temperature treatments on electron transport reactions for two desert succulents, Agave deserti and Opuntia ficus-indica, species which can tolerate 60°C. Whole chain electron transport averaged 3°C more sensitive to a 1-hour high-temperature treatment than did PSII (Photosystem II) which in turn averaged 3°C more sensitive than did PSI. For plants maintained at day/night air temperatures of 30°C/20°C, treatment at 50°C cause these reactions to be inhibited an average of 39% during the first hour, an additional 31% during the next 4 hours, and 100% by 12 hours. Upon shifting the plants from 30°C/20°C to 45°C/35°C, the high temperatures where activity was inhibited 50% increased 3°C to 8°C for the three electron transport reactions, the half-times for acclimation averaging 5 days for A. deserti and 4 days for O. ficus-indica. For the 45°C/35°C plants treated at 60°C for 1 hour, PSI activity was reduced by 54% for A. deserti and 36% for O. ficus-indica. Acclimation leads to a toleration of very high temperatures without substantial disruption of electron transport for these desert succulents, facilitating their survival in hot deserts. Indeed, the electron transport reactions of these species tolerate longer periods at higher temperatures than any other vascular plants so far reported.

5603 Chemicals Metabolism and Toxicology

Refer also to citation(s) 37158, 37561, 37600, 37622, 37626

37674 (ORNL/FTR–3129) **[Environmental toxicology]: Foreign trip report, November 11–21, 1988.** Travis, C.C. Oak Ridge National Lab., TN (USA). 28 Nov 1988. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012391. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler attended an International Seminar on Environmental Toxicology sponsored by Her Royal Highness Princess Chulabhorn of Thailand. The objective of the seminar was to provide technical knowledge in the area of environmental toxicology to participants from developing countries in Asia. Priorities identified at the workshop which would aid in the application of environmental toxicology principles in developing countries were: a data base on toxicological properties of chemicals, increased research support in all aspects of science and technology in developing countries, increased public awareness and participation in the risk management process, and an increased number of training courses held in third world countries to facilitate exchange of experience and techniques.

37675 (ORNL/FTR–3157) **[Health risk assessment on environmental, occupational, and life style hazards]: Foreign trip report, December 12–30, 1988.** Lu, Po-Yung. Oak Ridge National Lab., TN (USA). 10 Jan 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012390. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler was invited to visit NIHS, Tokyo, Japan, to give a lecture to the NIHS staff; traveler then participated in the Symposium on Health Risk Assessment on Environmental, Occupational, and Life Style Hazards, Taipei, Taiwan. Recommendations of the symposium were summarized as: to establish a research institution for risk assessment on environmental, occupational, and life style hazards; to establish a comprehensive data base for risk assessment associated with the above discipline for further information analysis; to establish public confidence through the risk assessment practice advisory committee to ensure scientific technical expertise; and to communicate the results of risk assessments through mass media and enhance public awareness of environmental contamination and associated social and economic impacts.

37676 (ORNL/M–1142) **TNT [trinitrotoluene] metabolites in animal tissues: Quarterly technical progress report No. 6, January 1–March 31, 1990.** Shugart, L.R. Oak Ridge National Lab., TN (USA). 1 Apr 1990. 14p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. Order Number DE90011273. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The overall objectives of this project are: to provide quantitative analytical procedures for the analysis of TNT and at least eight of its metabolites in animal tissues and to obtain representative samples of tissues from animals from designated Army sites, and to determine the presence or absence of TNT and its metabolites in these samples. The study is divided into two Phases corresponding to the stated overall objectives of the project. 3 figs., 2 tabs.

37677 (ORNL/M–1143) **Biological (molecular and cellular) markers of toxicity: Semi-annual technical progress report No. 3, October 1, 1989–March 31, 1990.** McCarthy, J.F. Oak Ridge National Lab., TN (USA). 1 Apr 1990. 24p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. Order Number DE90011290. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The overall objective of this study is to evaluate the use of the small aquarium fish, Japanese Medaka, as a predictor of potential genotoxicity following exposure to carcinogens. This will be accomplished by quantitatively investigating the early molecular events associated with genotoxicity of various tissues of Medaka subsequent to exposure of the organism to several known carcinogens, such as diethylnitrosamine (DEN) and benzo[a]pyrene (BaP). 11 refs., 1 fig., 1 tab.

37678 (ORNL/TM–11149) **Descriptions of research sites in the integrated forest study on effects of atmospheric deposition.** Bondiette, E.A. (ed.). Oak Ridge National Lab., TN (USA). Mar 1990. 128p. Sponsored by Electric Power Research Institute. DOE Contract AC05-84OR21400. Order Number DE90012033. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

Environmental Sciences Division Publication No. 3279.

This site descriptions report documents the site characteristics and site-specific measurement approaches of participating sites in the Integrated Forest Study on Effects of Atmospheric Deposition (IFS), a multiyear integrated research effort designed to improve our understanding of how chemicals which are deposited from the atmosphere influence the mineral nutrient cycles in forests. The research has been performed at a series of forested sites in the US, Canada, and Norway. 56 refs., 18 figs., 22 tabs.

37679 (TVA/LR/NRM–89/5) **Sixth annual Gatlinburg acid rain conference: Proceedings.** Weaver, L.A. (ed.). Tennessee Valley Authority, Knoxville, TN (USA). Oct 1989. 76p. Sponsored by Tennessee Valley Authority. (CONF-8910164–: 6. annual Gatlinburg acid rain conference, Gatlinburg, TN (USA), 30-31 Oct 1989). Order Number DE90012825. Available from NTIS, PC A05/MF A01 - OSTI.

This publication contains abstracts that are reports of completed or ongoing scientific studies. Topics include: greenhouse effect, air pollution impacts, effects of ozone, atmospheric deposition, and a regional analysis of the southeast. (KJD)

37680 (UBA-FB–89-063) **Dose-response-relationships for phytotoxic air pollutants, where no air quality standards have been established. Criteria for decision-making in special cases (TA Luft, 2.2.1.3).** Schulze, E. Umweltbundesamt, Berlin (Germany, F.R.). Apr 1989. 74p. (In German). Contract UFOPLAN-Nr. 11608076. Available from Copy held by UB/TIB Hannover.

Since 1983 'the Technical Instruction for maintaining air purity' has required, in the case of plant construction permits, an examination of whether potentially polluting substances for which no environmental standards exist could cause adverse environmental effects. The available scientific literature was reviewed and evaluated for 15 pollutant substances: ammonia, chlorine gas, gaseous hydrochloric acid, ethylene, formaldehyde, hydrogen sulphide, carbon disulphide, hydrogen cyanide, tetrachlorethene, tetrachloroethylene, dichloroethene, trichloroethene, trichloroethylene and the aromatics benzene, toluene and o-xylene. Literature is available only for the first six; the results are summarized in tables of effects scales (Tables 1-4 and 6). The most important biotic, abiotic and anthropogenic factors to be taken into account when assessing pollution risks are indicated. (orig.) With 97 refs., 6 tabs., 1 fig.

37681 (UBA-FB–89-158) **Changes in terrestrial ecosystems after long-term exposure to airborne pollutants - studies on the effects of ozone and NO_x immissions on spontaneous vegetation. Final report.** Maier-Reiter, W.; Siegerist, B.; Belotti, E. Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Landeskultur und Pflanzenoekologie; Umweltbundesamt, Berlin (Germany, F.R.). 1989. 167p. (In German). Contract UFOPLAN-Nr. 11608061. Available from Copy held by UB/TIB Hannover.

Experiments and results on the effects of ozone and nitrogenoxides, single and in combination, are given. As effects criterion morphological and yield parameters have been used with Central European 'wild-plants'. The concentrations chosen in the fumigation experiments are realistic and follow the daily pattern similar to those found in South-West Germany. Daily concentration courses seemed necessary after the little stinging nettel (Urtica urens) showed different effects after same doses of a steady fumigation compared to a concentration curve within 24 hours. The yield was generally reduced by ozone, and this has been more pronounced in the root section than at the shoot. Only some species reacted with NO_2, mainly with elevated leaf areas and/or leaf weights. Using plants from sites with different ozone burden, no effect on their ozone resistance in fumigation experiments were detectable. (orig.) With 100 refs., 29 tabs., 63 figs.

37682 Mercury-binding proteins in the slipper limpet, Crepidula fornicata, exposed to increased soluble mercury. Harrison, F.L. (Lawrence Livermore National Lab., CA (USA)); Watness, K.; Nelson, D.A.; Miller, J.E.; Calabrese, A. *Estuaries (USA)*, 10(1): 78-83 (Mar 1987).

Crepidula fornicata were held in a flow-through bioassay system and exposed to sand-filtered seawater to which no soluble mercury (control) was added or to which either 5, 25, or 50 $\mu g\ l^{-1}$ soluble Hg was added. At specific intervals during the 16-week experiment, a group of limpets was removed from each tank; one subgroup was exposed for 48 h to high concentrations of Hg, and another was analyzed for Hg-binding proteins by gel-permeation chromatography and spectrometry. Mortality from exposure to Hg in the 48-Hg acute toxicity tests was related to concentrations of Hg experienced both during the long-term exposure period and the 48-h exposure period. Chronic exposure to low levels of Hg resulted in increased amounts of total Hg in the whole body and in the low-molecular-weight Hg-binding proteins. No evidence was found for increased tolerance of Hg with preexposure.

5604 Other Environmental Pollutant Effects

37683 (DOE/CE/76246–T14) **Immunological and biochemical effects of 60-Hz electric and magnetic fields in humans: Phase 3: Quarterly report No. 6, January 1–March 31, 1987.** Graham, C.; Cohen, H.D. Midwest Research Inst., Kansas City, MO (USA). 9 Apr 1987. 5p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FC01-84CE76246. Order Number DE90012555. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Public concern has been expressed about the potential health risk associated with exposure to electric and magnetic fields generated by overhead power transmission lines. This project is addressing this concern through a research program designed to evaluate the effects of acute exposure to known field conditions on multiple measures of human function. Task 1 of the present project phase was completed during this reporting period. The goal of Task 1 was to perform another human exposure study on a larger sample of volunteers to verify and extend earlier project findings. Thirty subjects participated in a baseline session and four double-blind exposure sessions, spaced 1 week apart. Subjects were assigned at random to receive all sham exposure; all real exposure; mixed exposure in the order real-sham-sham-real; and mixed exposure in the order sham-real-real-sham. Performance and physiological data were collected before, during and after exposure. Biochemical and subjective report data were collected before, midway and after exposure. During this reporting period, project goals were to: complete data analysis for Task 1; prepare plans and protocols for Task 2; participate in a project review meeting; begin the first study on Task 2; and prepare a report of Task 1 findings.

37684 (DOE/CE/76246–T16) **Immunological and biochemical effects of 60-Hz electric and magnetic fields in humans: Phase 3, Quarterly report No. 9, October 1–December 31, 1987.** Graham, C.; Cohen, H.D. Midwest Research Inst., Kansas City, MO (USA). 8 Jan 1988. 4p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FC01-84CE76246. Order Number DE90012557. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Public concern has been expressed about possible health risks arising from exposure to powerline electric and magnetic fields. This project is addressing this concern through a research program designed to evaluate the effects of exposure to known field conditions on multiple measures of human function. The present phase of project activities began in October 1985, and will end in September 1988. Two of the three tasks to be accomplished in this phase have now been completed. During the present reporting period, project staff designed and began preparations for Task 3. These

plans were reviewed at the two project review meetings held in the present reporting period, and data collection on the Task 3 study is scheduled to begin in the next reporting period. Project goals during this reporting period were to: complete analysis of intermittent exposure study; attend the annual DOE/EPRI contractors review meeting; participate in project review meetings; and design and prepare for Task 3. Data collection for this study ended in the previous reporting period. The following activities were performed to complete the required statistical analyses: electrophysiological data were screened for artifacts, scored, and entered into the compute data base; urine samples were assayed for cortisol, dopamine, epinephrine, and norepinephrine; performance data were verified and entered into the data base; subjective data were verified and entered into the data base; and multivariate and univariate statistical tests were performed to evaluate the effects of the exposure conditions on the above measures.

37685 (DOE/CE/76254–9) **Magnetic fields and behavior: Annual performance report, 1989–1990.** Laties, V.G.; Stern, S. Rochester Univ., NY (USA). Mar 1990. 3p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-85CE76254. Order Number DE90012635. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This annual report gives the results of exposing rats to 60H_3 electromagnetic fields of various intensities. Test results have not confirmed previous studies that have reported altered animal behavior after exposure to electromagnetic fields. (FSD)

37686 (ORNL/FTR–2875) **[Low frequency electromagnetic fields and public health]: Foreign trip report, April 30–May 8, 1988.** Aldrich, T.E. Oak Ridge National Lab., TN (USA). 23 May 1988. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012381. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler participated in the IARC-sponsored workshop entitled "Extremely Low Frequency Electromagnetic Fields (EMF) and Public Health" where he delivered the keynote address. This address set the stage for deliberations among the EMF public health professionals regarding strategies for international collaborative work on this topic. Strong emphasis was placed in explicit exposure monitoring. The traveler also participated in the Tenth Yves Biraud Seminar on rare-event surveillance as a sentinel system for detection potential environmental hazards. He presented an invited paper describing a means for making rapid, preliminary decisions regarding potential health impacts due to contamination of the environment around point sources of toxic substances. He served as the symposium's expert on numerical techniques on the use of spatial and temporal aggregation of rare health events. There is considerable variation among countries in emphasis on application of sentinel systems and application of sentinel systems and data gathering. France has a highly automated, statistically-sophisticated system involving individual physician reporting of specific reportable infectious diseases to a central location. The European Common Market nations are sold on this concept and are supporting the development of an internationally coordinated system.

37687 (PNL–7370) **An evaluation of the environmental fate and behavior of munitions materiel (TNT, RDX) in soil and plant systems: Environmental fate and behavior of TNT [trinitrotoluene]: Final report.** Cataldo, D.A.; Harvey, S.D.; Fellows, R.J.; Bean, R.M.; McVeety, B.D. Pacific Northwest Lab., Richland, WA (USA). Aug 1989. 97p. Sponsored by U.S. Department of Defense. DOE Contract AC06-76RL01830. Order Number DE90012748. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The objective of these investigations was to elucidate the environmental behavior and fate of trinitrotoluene (TNT). Emphasis was placed on those chemical transformations occurring in soils and in plant tissues following uptake and on the probable impact of these chemical transformations on the food chain. Analytical methodology was developed to fractionate and characterize both TNT and TNT-derived residues in soil and plant matrices. The procedures developed in this program extend prior art, through the use of matrix-specific extraction and fractionation schemes followed by classical HPLC separations. Methods showed good recovery and reproducibility. 30 refs., 35 figs., 27 tabs.

57 HEALTH AND SAFETY

Refer also to citation(s) 36806, 37016, 37385

58 GEOSCIENCES

Refer also to citation(s) 36721, 36722, 36739, 36743, 36754, 36755, 36756, 36758, 36767, 36768, 36770, 36771, 36791, 36873, 37287, 37388, 37615, 37963

37688 (PB–90-184433/XAB) **Dating of lithic artifacts by counting radon-produced particle tracks. Phase 1. Final report.** Blatchley, C.C. Spire Corp., Bedford, MA (USA). Apr 1987. 17p. (FR–60072). Available from NTIS, PC A03/MF A01.

The feasibility of artificially enhancing the sensitivity of natural materials to the point of registering alpha particles produced by radon decay daughters was tested with negative results. Since low concentrations of natural radon in the atmosphere alpha-decay in contact with exposed surfaces of a lithic tool or flake, the gradually accumulated alpha tracks on such a surface should indicate when the artifact was manufactured as opposed to the internally produced fission fragment record of when the material was formed. Previous work with highly sensitive plastics indicated that doses of radiation in the million rad range, electric potentials, and very slow etching conditions may enhance the contrast between bulk etch rates and particle track etch rates. Tests of such treatments were performed on materials such as rhyolite, chert, and argillite, commonly used by prehistoric cultures for tool manufacture. None of the materials tested displayed any significant variation in etch rate as a function of gamma or alpha radiation dose regardless of etchant or etching condition.

37689 (PB–90-915700/XAB) **Smithsonian Institution: Bulletin of the Global Volcanism Network. Monthly report.** National Museum of Natural History, Washington, DC (USA). 1990. vp. Available from NTISSubscription.

Supersedes PB–89-915700. Paper copy available on subscription, North American Continent price $95.00/year; all others write for quote. Also available in single copies. Formerly SEAN (Scientific Event Alert Network) Bulletin.

Scientific Event Alert Network is a monthly bulletin reporting timely information on worldwide natural science events such as volcanic eruptions, earthquakes, fireballs, meteorite falls and finds, marine mammal strandings and sightings, discoveries of unusual natural history specimens, and population biology events, including migrations, diseases and afflictions, and mortalities.

37690 (USGS-OFR–89-3) **Stratigraphic correlation and petrography of the bedded tuffs, Yucca Mountain, Nye County, Nevada.** Diehl, S.F.; Chornack, M.P. Geological Survey, Denver, CO (USA). 1990. 152p. Sponsored by U.S. Geological Survey. DOE Contract AI08-78ET44802. Order Number DE90013464. Available from NTIS, PC A08/MF A01; OSTI; INIS; USGS Books and Open File Reports Section, Box 25425 Federal Center, Denver, CO 80225; GPO Dep.

Bedded tuffs serve as stratigraphic markers between the major ash- flow tuffs at Yucca Mountain, Nye County, Nevada. The bedded tuffs can be divided on the basis of their mode of deposition into pyroclastic-fall, pyroclastic-surge, and nonwelded pyroclastic-flow deposits; each of these deposits may have weathered surfaces. There has been minimal study of the origin and lateral continuity of the individual beds that comprise bedded-tuff units at Yucca Mountain. The major objective of this study is to subdivide sequences of bedded tuffs and to correlate these units between core holes. Another objective of this study is to define macroscopic, petrographic, and scanning electron microscope (SEM) criteria that can be used to subdivide the bedded-tuff deposits with respect to their depositional origin. 31 refs., 35 figs., 7 tabs.

64 PHYSICS I

6401 Astrophysics and Cosmology

Refer also to citation(s) 37804

37691 (FRNC-TH–3449) **Acceleration and propagation of cosmic rays. Production, oscillation and detection of neutrinos.** Lagage, P.O. Paris-7 Univ., 75 (France). 1987. 140p. (In French). Order Number DE90502113. Available from NTIS (US Sales Only), PC A07/MF A01.

This thesis is devoted to studies on cosmic rays and neutrinos, particles astrophysically relevant. In recent years, the old problem of cosmic-ray acceleration and propagation has become alive again, with the discovery of the diffusive shock acceleration mechanism, and with the first measurements of the cosmic-ray antiproton flux, which appears to be higher than expected. I have shown that the new acceleration mechanism was slow and I have calculated the maximum energy that can be reached by particles accelerated in various astrophysical sites. I have also studied in detail a cosmic-ray propagation model which takes into account the antiproton measurements. Neutrino astronomy is a field much more recent and in rapid expansion, thanks to a convergence of interests between astrophysicists and elementary particle physicists. Several large neutrino detectors already exist; really huge ones are in project. I have studied the possible impact of the high energy (> 1 TeV) neutrino astronomy on models of cosmic-ray sources such as Cygnus X3. Comparing the low energy (≈ 10 MeV) cosmic-ray antineutrinos with other sources of neutrinos and antineutrinos (sun, supernova, earth ...), I have pointed out that the antineutrino background resulting from all the nuclear power-stations of the planet was sizeable. This background is a nuisance for some astrophysical applications but could be useful for studies on vacuum or matter neutrino oscillations (MSW effect). I have also examined the MSW effect in another context: the travel through the earth of neutrinos from the supernova explosion SN1987a.

37692 (MPE–174(prepr.)) **X-ray observations of gamma-ray burst sources.** Boer, M. (Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik); Gottardi, M.; Hurley, K.; Pizzichini, G. Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik. Feb 1990. 15p. Available from Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.

We report on preliminary results of EXOSAT observations of three gamma-ray burst error boxes. No source was detected down to a limit of 10^{-10} erg.cm^{-2}.s^{-1}, assuming a blackbody spectrum for the burst counterpart. Results are interpreted in the framework of current theoretical models. (orig.).

37693 (PB–90-195363/XAB) **Solar-Geophysical Data Number 546, February 1990. Part 1 (prompt reports). data for January 1990, December 1989, and late data.** Coffey, H.E. National Geophysical Data Center, Boulder, CO (USA). Feb 1990. 164p. (SGD–546-PT-1). Available from NTIS, PC A08/MF A01.

See also PB–89-173041 and PB–87-233169.

Contents include: detailed index for 1989-1990; data for January 1990–solar-terrestrial environment, IUWDS alert periods (advance and worldwide), solar activity indices, solar flares, solar radio emission, Stanford mean solar magnetic field; data for December 1989–solar-active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic-ray measurements by neutron monitor, geomagnetic indices; late data–cosmic-ray measurements by neutron monitor, reprint of halftone-page Kitt Peak solar magnetic field synoptic chart November 1989.

37694 (PB–90-195371/XAB) **Solar-Geophysical Data Number 546, February 1990. Part 2 (comprehensive reports). Data for August 1989 and miscellaneous.** Coffey, H.E. National Geophysical Data Center, Boulder, CO (USA). Feb 1990. 184p. (SGD–546-PT-2). Available from NTIS, PC A09/MF A01.

See also Part 1, PB–90-195363, PB–89-173058 and PB–87-233169.

Contents: detailed index for 1989-1990; data for august 1989–solar flares, solar radio bursts at fixed frequencies, solar x-ray radiation from GOES satellite, mass ejections from the sun, active prominences and filaments; miscellaneous data–Meudon Carte Synoptique - Carrington rotations 1816-17 June 1989, interplanetary solar particles.

37695 (UCRL-JC–103406) **Radio loud far-infrared galaxies.** Dey, A (California Univ., Berkeley, CA (USA). Dept. of Astronomy); Shields, J.C.; Van Breugel, W.J.M. Lawrence Livermore National Lab., CA (USA). Mar 1990. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90012993. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We present the first results of a multiwavelength study of IRAS galaxies with excess radio emission. The sample was selected by cross-correlating the IRAS Faint Source Survey (for $|b| \geq 50°$) and the Point Source Catalogue (for $10° < |b| < 50°$) with the Texas radio survey. Recent optical (imaging and spectroscopic) and radio (VLA) observations are discussed. These observations will be used to investigate possible connections between radio galaxy activity, star formation and galaxy interactions. 15 refs., 3 figs.

37696 (UCRL-JC–104223) **A site for the astrophysical gamma-ray process.** Howard, W.M. (Lawrence Livermore National Lab., CA (USA)); Meyer, B.S.; Woosley, S.E. Lawrence Livermore National Lab., CA (USA). Apr 1990. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9006212–1: International symposium on nuclear astrophysics: nuclei in the cosmos, Vienna (Austria), 18-22 Jun 1990). Order Number DE90013473. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The origin of the proton-rich isotopes of the heavy elements in nature has been studied for over thirty years. Specifically, the p-isotopes are those stable nuclear isotopes with mass number $74 \lesssim A$ that lie on the proton-rich side of the valley of beta-stability and are bypassed by the neutron capture chains that are thought responsible for producing the bulk of the heavy elements. A leading model for the origin of the p-isotopes involves transmuting heavy elements into lighter p-isotopes via a series of nuclear photodisintegrations involving (γ,n), (γ,p) and (γ,α) reactions. Such a model,called the gamma-process, is quite successful in reproducing the bulk of the rare p-isotopes if one assumes a solar-system distribution of heavy elements, temperatures in the range $2.0 \lesssim T_9 \lesssim 3.0$ and a hydrodynamical expansion timescale of order 1 sec. Such thermodynamic conditions occur quite naturally when the neon-oxygen layers of massive stars ($M > 10M_\odot$) undergo type II supernovae explosions. However, a major failure of this model is that the solar-system abundance pattern of some light p-isotopes is not well reproduced due to a lack of sufficient seeds with $A > 96$. Enhancing the heavy elements with prior s-processing during core helium burning is insufficient because the peak of such a s-process distribution is only near A = 80. Proton captures play no role in the gamma-process because in the neon-oxygen rich layer the proton mass density is too low to induce captures on the relevant timescales. However, neutron captures may slightly modify the distribution. In this paper we propose that the requisite thermodynamic conditions may also occur in Type Ia supernovae, when carbon-oxygen white dwarfs explode by deflagration.

37697 **Gamma-ray astronomy at 1 TeV.** Vacanti, G. (Iowa State University, Ames, IA 50011 (US)). *AIP Conference Proceedings (American Institute of Physics) (USA),* 203(1): 196-202 (20 Mar 1990). (CONF-8911161–: Particle astrophysics: NASA cosmic ray program for the 1990's and beyond, Greenbelt, MD (USA), 6-8 Nov 1989).

An outline of some problems and ideas of TeV ground based γ-ray astronomy is given, with particular attention to the Imaging Technique. The current observational status of Cygnus X-3 and Hercules X-1 is then reviewed.

37698 **Current and future uses of accelerators in particle astrophysics.** Guzik, T.G. (Louisiana State University, Baton Rouge, LA 70803 (US)). *AIP Conference Proceedings (American Institute of Physics) (USA),* 203(1): 275-284 (20 Mar 1990). DOE Contract FG05-84ER40147. (CONF-8911161–: Particle astrophysics: NASA cosmic ray program for the 1990's and beyond, Greenbelt, MD (USA), 6-8 Nov 1989).

Beams of artificially accelerated heavy ions, p, $\bar{p}$, e^- and e^+ currently available at (and planned for) numerous facilities around the world are a valuable resource to the Cosmic Ray community. Such beams have been used to test detector concepts, calibrate balloon-borne and space flight experiments and to measure fundamental nuclear physics parameters necessary for the interpretation of Cosmic Ray data. As new experiments are flown the quality and extent of Cosmic Ray measurements will continue to improve. It will be necessary to increase activity at ground based accelerators in order to test/calibrate these new instruments and to maintain (or possibly improve) our ability to interpret these data. In this area, the newly formed *Transport Collaboration*, supported by NASA, will be providing new nuclear interaction cross section measurements for beams with $Z \lesssim 58$ and supporting new instrument calibrations at the Lawrence Berkeley Laboratory Bevalac accelerator.

37699 The experimental search for point sources above 1 TeV. Goodman, J.A. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742-4111 (USA)); The GRANDE Collaboration; The CYGNUS Collaboration. *AIP Conference Proceedings (American Institute of Physics) (USA)*, 203(1): 203-209 (20 Mar 1990). (CONF-8911161–: Particle astrophysics: NASA cosmic ray program for the 1990's and beyond, Greenbelt, MD (USA), 6-8 Nov 1989).

The search for point sources of VHE and UHE radiation is an exciting new field which bridges Astrophysics and High Energy physics. This paper describes three experiments to study this radiation: The first is the CYGNUS experiment in Los Alamos which has been operational since 1986 and is sensitive to the electromagnetic and muonic component of extensive air showers above 5×10^{13} eV. The second is the proposed GRANDE detector which will be capable of detecting all components of extensive air showers above 10^{13} eV and detecting upward coming muons from neutrino induced events in the rock below it. An third a new experiment, MILAGRO, to study the electromagnetic and muonic component of extensive air showers above 10^{12} eV is described.

37700 Hyperextended inflation. Steinhardt, P.J. (School of Natural Sciences, Institute for Advanced Study, Princeton, New Jersey 08540 (US)); Accetta, F.S. *Physical Review Letters (USA)*, 64(23): 2740-2743 (4 Jun 1990). DOE Contract AC02-76ER03075.

We present a dynamical mechanism for completing inflationary phase transitions via bubble nucleation which can satisfy all known constraints for a wide spectrum of models and parameters. The approach is a generalization of the recent "extended inflation" model which corrects a serious flaw. We find an essentially model-independent bubble-size distribution which may be important for large-scale structure.

37701 Interpretation of the kinematical properties of SN 1987A neutrino data by an admixture of $\nu_\mu,\nu_{\tilde{\mu}}$ and $\nu_\tau,\nu_{\tilde{\tau}}$. Kielczewska, D. (Physics Department, University of California at Irvine, Irvine, California 92717 (US)— Instytut Fizyki Doswiadczalnej, Warsaw University, Hoza 69, Warsaw, Poland). *Physical Review, D (Particles Fields) (USA)*, 41(10): 2967-2975 (15 May 1990).

Statistical tests suitable for small data samples are used to compare the observed energies and angles of the SN 1987A neutrino events with distributions expected for a range of assumed temperatures and relative luminosities of different neutrino species. The highest confidence levels are obtained for simulated samples with an admixture of $\nu_\mu,\nu_{\tilde{\mu}}$ and $\nu_\tau,\nu_{\tilde{\tau}}$ added to the $\nu_{\tilde{e}}$ interactions. This is a consequence of relatively high-energy thresholds [particularly for the Irvine-Michigan-Brookhaven (IMB) detector] and $\nu_\mu,\nu_{\tilde{\mu}},\nu_\tau,\nu_{\tilde{\tau}}$ energies being greater than those of $\nu_{\tilde{e}}$. It is also found that a $\nu_\mu,\nu_{\tilde{\mu}},\nu_\tau,\nu_{\tilde{\tau}}$ admixture is more probable than a ν_e contribution for which the IMB detector is especially inefficient. A possibility of identifying $\nu_\mu,\nu_{\tilde{\mu}}$ and $\nu_\tau,\nu_{\tilde{\tau}}$ interactions from a future supernova collapse is also discussed.

37702 Constraints for toroidal cosmology. McGuigan, M. (School of Natural Sciences, Institue for Advanced Study, Princeton, New Jersey 08540 (US)). *Physical Review, D (Particles Fields) (USA)*, 41(10): 3090-3100 (15 May 1990). DOE Contract AC02-76ER02220.

We discuss the constraints for a universe with the spatial topology of a $(d-1)$-dimensional torus and metric G_{ij}. We argue that if dynamical duality exists it should lead to an $O(d-1,d-1,Z)$-invariant metric on superspace. We give an example of an indefinite $O(d-1,d-1,Z)$-invariant metric on the superspace (G_{ij},B_{ij}) where B_{ij} is the antisymmetric tensor field. On the hypersurface $B_{ij}=0$ duality represents a parity time-reversal transformation of superspace.

37703 Eternal annihilations: New constraints on long-lived particles from big-bang nucleosynthesis. Frieman, J.A. (NASA/Fermilab Astrophysics Center, Fermi National Accelerator Laboratory, Batavia, Illinois 60510-0500 (US)); Kolb, E.W.; Turner, M.S. *Physical Review, D (Particles Fields) (USA)*, 41(10): 3080-3085 (15 May 1990).

In the early Universe, the relative abundance of a massive weakly interacting particle species "freezes out" when the annihilation rate becomes less than the expansion rate. Although ineffective in reducing the total number of the species, occasional annihilations still occur after freeze-out. The residual annihilations of massive particles ($10\ \text{MeV} \lesssim m_X \lesssim 1\ \text{GeV}$) after primordial nucleosynthesis can strongly alter the light-element abundances through photodissociation. For particles with typical weak-interaction cross sections and lifetimes $\tau_X \gtrsim 5 \times 10^6$ sec, we find that the mass range $m_X \lesssim 1$ GeV is ruled out, independent of how they subsequently decay.

6402 Atmospheric Physics

Refer also to citation(s) 37693, 38055

37704 (AD-A–218407/5/XAB) **Coordinated observations of high-latitude ionospheric turbulence.** Basu, S.; Basu, S.; Valladares, C.E.; Weber, E.J.; Buchau, J. Air Force Geophysics Lab., Hanscom AFB, MA (USA). 1988. 19p. (GL-TR–90-0023). Available from NTIS, PC A03/MF A01.

Pub. in Physics of Space Plasmas, SPI Conference Proceedings and Reprint Series, Vol. 8, 137-151(1988). Original contains color plates; All DTIC and NTIS reproductions will be in black and white.

A coordinated data set comprised of scintillation, ionosonde, incoherent scatter radar and optical measurements obtained on two nights during the CEDAR/WITS campaign of February, 1988 was selected for the study of two distinct classes of high latitude plasma turbulence. Under IMP Bz northward conditions, the polar cap arc detected by the all-sky imaging photometer (ASIP) in this phase of low solar activity (SSN=40) was found to be associated with a total electron content enhancement of only 2x10 to the 16th power/sq. m and weak amplitude scintillations (S sub 4 about = 0.35) at 250 MHz. The photometer and scintillation measurements indicated that in addition to the dawn to dusk motion of 200/ms in the inertial frame, there existed enhanced plasma motion of about 400/ms along the arc. The second data set conforming to IMF Bz southward condition showed the existence of ionization patches in the polar cap and their anti-sunward motion towards the auroral oval. The polar cap patches detected deep within the polar cap with electron contents as large as 10x10 to the 16th power/sq. m caused 15 dB scintillations at 250 MHz. These patches detected close to the auroral oval also caused strong scintillations which indicated that the patches get continually structured during their convection through the winter polar cap.

37705 (RAL–90-009) **Two theories of auroral electron acceleration.** Bryant, D.A. Rutherford Appleton Lab., Chilton (UK). Mar 1990. 34p. (CONF-8905288–: Spring college of plasma physics meeting, Trieste (Italy), May 1989). Order Number DE90631220. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Two theories of auroral electron acceleration are discussed. The first is the currently widely held view that the acceleration is an ordered process in a quasi-static electric field. It is suggested that, although there are many factors seeming to support this theory, the major qualifications and uncertainties that have been identified combine to cast serious doubt over its validity. The second is a relatively new interpretation in terms of stochastic acceleration in turbulent electric fields. This second theory, which appears to account readily for most known features of the electron distribution function, is considered to provide a more promising approach to this central question in magnetospheric plasma physics. (author).

37706 Stimulated thermal Rayleigh scattering threshold induced by velocity turbulence. Viecelli, J.A. (Lawrence Livermore National Laboratory, Livermore, California 94550 (US)). *Optics Letters (USA)*, 15(11): 598-600 (1 Jun 1990). DOE Contract W-7405-ENG-48.

Numerical integration of the time-dependent propagation equations for a turbulent medium shows that velocity turbulence introduces a threshold for small-angle stimulated thermal Rayleigh scattering. The threshold can be expressed in terms of a formula relating the limit on absorbed power to the rms amplitude of the velocity fluctuations. Above threshold, light scattered by thermal fluctuations at the start of the path is amplified. After only a few waves of phase distortion have accumulated, the stimulated scattering amplitude reaches saturation. Below threshold, stimulated scattering is suppressed, but there is a slow increase in the level of the index turbulence caused by incoherent heating of the propagation medium.

6403 Atomic, Molecular, and Chemical Physics

Refer also to citation(s) 36839, 37206, 37210, 37257, 37305, 37328, 37329, 37414, 37415, 37539, 37568, 37836, 37953, 37959, 38057, 38076, 38079, 38084, 38289, 38296, 38298, 38301

37707 (ANL/APS-TM-6) **Workshop on high heat load x-ray optics.** Argonne National Lab., IL (USA). Advanced Photon Source Div. Jan 1990. 528p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. (CONF-890874--: Workshop on high heat load x-ray optics, Argonne, IL (USA), 3-5 Aug 1989). Order Number DE90011799. Available from NTIS, PC A22/MF A01; OSTI; INIS; GPO Dep.

A workshop on "High Heat Load X-Ray Optics" was held at Argonne National Laboratory on August 3–5, 1989. The object of this workshop was to discuss recent advances in the art of cooling x-ray optics subject to high heat loads from synchrotron beams. The cooling of the first optical element in the intense photon beams that will be produced in the next generation of synchrotron sources is recognized as one of the major challenges that must be faced before one will be able to use these very intense beams in future synchrotron experiments. Considerable advances have been made in this art during the last few years, but much work remains to be done before the heating problem can be said to be completely solved. Special emphasis was placed on recent cooling experiments and detailed "finite element" and "finite difference" calculations comparing experiment with theory and extending theory to optimize performance.

37708 (ANU-P-1046) **The populations of Rydberg states of ions emerging from solid surfaces.** Hay, H.J.; Treacy, P.B. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. Sep 1989. 12p. Order Number DE90630660. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

To be published in Nucl. Instrum. Methods Phys. Res., Sect. B.

Analysis of decays of Rydberg ions produced in beam-foil conditions shows that populations are observed to emerge in the form $n^{-\beta}$, where n is the principal quantum number and the index β is significantly less than the value 3 expected from most capture models. For 130 MeV Br ions excited by carbon, the high angular momentum ('l') cascade may be described by β=3 with a truncated 'l'-value, but a direct cascade, with l = 0, requires β = 2.4. A calculation is described of the effects of the in-target stopping power causing a change of the initial population via Landau-Zener type level anti-crossings. Evidence is shown that the low-'l' population does suffer a reduction of β through this mechanism. 15 refs., 3 figs.

37709 (DOE/ER/13889-2) **Accurate alpha sticking fractions from improved calculations relevant for muon catalyzed fusion: Final report.** Szalewicz, K. Delaware Univ., Newark, DE (USA). Dept. of Physics and Astronomy. May 1990. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER13889. Order Number DE90012886. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Recent experiments have shown that under proper conditions a single muon may catalyze almost two hundred fusions in its lifetime. This process proceeds through formation of muonic molecular ions. Properties of these ions are central to the understanding of the phenomenon. Our work included the most accurate calculations of the energy levels and Coulombic sticking fractions for tdμ and other muonic molecular ions, calculations of Auger transition rates, calculations of corrections to the energy levels due to interactions with the most molecule, and calculation of the reactivation of muons from α particles. The majority of our effort has been devoted to the theory and computation of the influence of the strong nuclear forces on fusion rates and sticking fractions. We have calculated fusion rates for tdμ including the effects of nuclear forces on the molecular wave functions. We have also shown that these results can be reproduced to almost four digit accuracy by using a very simple quasifactorizable expression which does not require modifications of the molecular wave functions. Our sticking fractions are more accurate than any other theoretical values. We have used a more sophisticated theory than any other work and our numerical calculations have converged to at least three significant digits.

37710 (LAL-RT-89-01) **Study of a positron source generated by photons from ultrarelativistic channeled particles.** Chehab, R. (Paris-11 Univ., 91 - Orsay (FR). Lab. de l'Accelerateur Lineaire); Couchot, F.; Nyaiesh, A.R.; Richard, F.; Artru, X. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Mar 1989. 3p. (CONF-890335--: 1989 IEEE particle accelerator conference, Chicago, IL (USA), 20-23 Mar 1989). Order Number DE90500797. Available from NTIS (US Sales Only), PC A02/MF A01.

Radiation by channeled electrons in Germanium and Silicon crystals along the <110> axis is studied as a very promising photon source of small angular divergence for positron generation in amorphous targets. Radiation rates for different crystal lengths - from some tenths of mm to 10 mm - and two electron incident energies, 5 and 20 GeV, are considered and a comparison between the two crystals is presented. Thermic behaviour of the crystal under incidence of bunches of 10^{10} electrons is also examined. The corresponding positron yields for tungsten amorphous converters - of 0.5 and 1 X_o thickness - are calculated considering the case of a Germanium photon generator. Assuming a large acceptance optical matching system as the adiabatic device of the SLC, accepted positrons are evaluated and positron yields larger than 1 e^+/e^- are obtained.

37711 (LAL-RT-89-02) **Positron sources.** Chehab, R. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Jan 1989. 30p. (CONF-8809376--: CAS CERN Accelerator School: 3. general accelerator physics course, Salamanca (Spain), 19-30 Sep 1988). Order Number DE90500801. Available from NTIS (US Sales Only), PC A03/MF A01.

A tentative survey of positron sources is given. Physical processes on which positron generation is based are indicated and analyzed. Explanation of the general features of electromagnetic interactions and nuclear β^+ decay makes it possible to predict the yield and emittance for a given optical matching system between the positron source and the accelerator. Some kinds of matching systems commonly used - mainly working with solenoidal fields - are studied and the acceptance volume calculated. Such knowledge is helpful in comparing different matching systems. Since for large machines, a significant distance exists between the positron source and the experimental facility, positron emittance has to be preserved during beam transfer over large distances and methods used for that purpose are indicated. Comparison of existing positron sources leads to extrapolation to sources for future linear colliders.

37712 (LAL-RT-89-03) **Electron sources.** Boussoukaya, M. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Jan 1989. 17p. (CONF-8809376--: CAS CERN Accelerator School: 3. general accelerator physics course, Salamanca (Spain), 19-30 Sep 1988). Order Number DE90500799. Available from NTIS (US Sales Only), PC A03/MF A01.

High thermo-emissive and photoemissive nanosecond and picosecond e^- sources are under investigation at many laboratories in different countries. An example of a thermionic e^- source is described and the problems met with different kinds of laser driven

photocathodes are presented. Finally, the details and results obtained with such sources are given.

37713 (NAC-AR–88-01, pp. 191-194) **Atomic physics: Beam foil spectroscopy.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

Beam foil spectroscopy is used to excite outer-shell atomic transitions which are generally not observable by other spectroscopic techniques. The excitations of the outer atomic shells are induced by passing an accelerated atomic beam through a thin carbon foil. 2 figs., 2 refs., 1 tab.

37714 (ORNL/FTR–2898) **[Multiphoton spectroscopy of molecules]: Foreign trip report, May 16, 1988–June 1, 1988.** Miller, J.C. Oak Ridge National Lab., TN (USA). 16 Jun 1988. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012376. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveller spent two weeks interacting with S. Leach and D. Gauyacq and their colleagues on topics relevant to the traveller's own research at ORNL. A seminar was presented on "Multiphoton Spectroscopy of Nitric Oxide." The traveller participated in ongoing experiments on Zeeman effects on the multiphoton ionization of nitric oxide. Visits to nearby labs at Saclay and Meudon were very enlightening.

37715 (ORNL/TM–11202) **Electron-impact ionization data for the nickel isonuclear sequence.** Pindzola, M.S.; Griffin, D.C.; Bottcher, G.C.; Buie, M.J.; Gregory, D.C. Oak Ridge National Lab., TN (USA). Mar 1990. 61p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012034. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

Atomic data for the electron impact ionization of ions in the nickel isonuclear sequence are reviewed. In 8 of the 28 ions of the nickel isonuclear sequence, experiment and theory are compared. In many of the ions, excitation-autoinization contributions to the total cross section are found to be quiet important. For intermediate charge state ions a large fraction on the experimental cross section may be attributed to ionization from metastable levels of low-lying excited configurations. Maxwellian collisional rate coefficients are calculated from the cross section data and presented in tabular, graphical, and parametrized form. 17 refs., 29 figs., 6 tabs.

37716 (ORNL/TM–11442) **Potential applications of an electron cyclotron resonance multicusp plasma source.** Tsai, C.C.; Berry, L.A.; Gorbatkin, S.M.; Haselton, H.H.; Roberto, J.B.; Schechter, D.E.; Stirling, W.L. Oak Ridge National Lab., TN (USA). Mar 1990. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012027. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

An electric cyclotron resonance (ECR) multicusp plasmatron has been developed by feeding a multicusp bucket arc chamber with a compact ECR plasma source. This novel source produces large (about 25-cm- diam), uniform (to within $\pm 10\%$), dense ($>10^{11}$–cm^{-3}) plasmas of argon, helium, hydrogen, and oxygen. It has been operated to produce an oxygen plasma for etching 12.7-cm (5-in.) positive photoresist-coated silicon wafers with uniformity within $\pm 8\%$. Following a brief review of the large plasma source developed at Oak Ridge National Laboratory, the configuration and operation of the source are described and a discharge model is presented. Results from this new ECR plasma source and potential applications for plasma processing of thin films are discussed. 21 refs., 10 figs.

37717 (RCNP-P–107, pp. 45-51) **Physics study with muons.** Nishiyama, K. (Tokyo Univ. (Japan). Meson Science Lab.). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

Muon, with its unique mass, lifetime, and also asymmetry of it's decay, is very important and useful tools for physics today. As an exotic and active probe, it is used in muon catalized fusion experiment and solid state physics. (author).

37718 (RCNP-P–107, pp. 52-59) **Chemistry of pionic atoms.** Shinohara, A. (Nagoya Univ. (Japan). Faculty of Science). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

The mechanism and the chemical effect of pion capture by material were studied from the standpoint of chemistry. The experimental method and some results are described and the future project is discussed. A plan of similar studies is also discussed in the framework of 'Cyclotron Cascade Project' of RCNP. (author).

37719 (RCNP-P–107, pp. 60-66) **Inverse internal conversion processes.** Mukoyama, Takeshi (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

Several processes considered as inverse internal conversion are reviewed. Monoenergetic positron emission and nuclear excitation by positron annihilation, and nuclear excitation by free-electron capture are briefly described. The experimental result of the latter process for uranium in laser-induced plasma and future study for highly-ionized ions are discussed. (author).

37720 **Nuclear-induced UV fluorescence.** Williams, W.H. (Illinois Univ., Urbana, IL (USA). Fusion Studies Lab.); Miley, G.H. pp. 133 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Previous work has indicated electrically and nuclear-stimulated gas emissions can be similar in overall spectral characteristics. Using standard gas discharge emission data, the emission spectra for select pure gases has been analyzed and compared to the photodissociation spectra of CF_3I and C_3F_7I between 230 and 330 nm. Of the potentially suitable gases, neon shows the best overlap (as defined by the product of fluorescence output and dissociation cross-section at a specific wavelength, summed over wavelengths between 230 and 330 nm), followed by krypton, chlorine, radon, xenon, helium, and fluorine. The best overlap is approximately a factor of 25 greater than the worst.

37721 **Structure-energy correlation for grain boundaries in F.C.C. metals: I. boundaries on the (111) and (100) planes.** Wolf, D. (Materials Science Div., Argonne National Lab., Argonne, IL (US)). *Acta Metallurgica (USA),* 37(7): 1983-1994 (Jul 1989). DOE Contract W-31-109-ENG-38.

The zero-temperature energies and equilibrium volume expansions of point-defect free grain boundaries (GBs) on the two densest planes of f.c.c. Cu have been determined using an embedded atom method (EAM) and a Lennard–Jones (LJ) potential. It is found that the energies and volume expansions of the (100) boundaries are about 2–3 times larger than those of the (111) boundaries. This correlation between the GB energy and the densest planes is analyzed in terms of the structural disorder in the interface region. A close correlation between large volume expansion and high GB energy is observed. Since both potentials yield qualitatively very similar results it is concluded that the short-range repulsion between atoms is the dominating contribution to the energy in the GB region and that therefore, electronic effects arising from a local volume dependence of the interatomic interactions are relatively unimportant.

37722 **Test of the linearity of quantum mechanics in an atomic system with a hydrogen maser.** Walsworth, R.L. (Lyman

Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138 (USA)); Silvera, I.F.; Mattison, E.M.; Vessot, R.F.C. *Physical Review Letters (USA),* 64(22): 2599-2602 (28 May 1990). DOE Contract FG02-85ER45190.

We extend a nonlinear generalization of quantum mechanics, recently formulated by Weinberg, to systems of composite spin, such as atoms. We have used hydrogen (H) masers to set a limit of 3.7×10^{20} eV (8.9 μ Hz) on the magnitude of a nonlinear correction to the quantum mechanics of atomic spins. This result is of comparable magnitude to the limit recently set in a single-valued (nuclear) spin system. In the absence of nonlinear effects, the experiment provides a new and stringent test of H-maser clock performance and the applicability of standard maser theory.

37723 Atomic electron binding energies of multiply charged krypton ions by internal-conversion-electron spectroscopy. Decman, D.J. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550 (US)); Stoeffl, W. *Physical Review Letters (USA),* 64(23): 2767-2770 (4 Jun 1990). DOE Contract W-7405-ENG-48.

We determined electron binding energies from multiply charged Kr ions from internal-conversion-electron spectra for the 9.4-keV transition in $^{83}Kr^m$. Because our radioactive source is a low-density gas, we can observe the electrons from ionic states produced by the vacancy cascade of the preceding highly converted transition. We report binding-energy shifts for the 2*s*, 3*s*, and 4*s* orbitals in the configuration of the atomic ground state. For charge state 7+, i.e., for Ni-like Kr and higher, we also observe the shifts from metastable states.

37724 Relativistic effects on the *s*→*d* promotion energy and spin-polarization energy of the transition metals. Wang, Y.J. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794 (USA)); Davenport, J.W. *Physical Review, A (General Physics) (USA),* 41(9): 4690-4695 (1 May 1990). DOE Contract AC02-76CH00016.

We have calculated the total energy of 3*d*, 4*d*, and 5*d* transition elements by a local-spin-density approximation with a "fully relativistic" treatment for core levels and a "scalar-relativistic" approximation for valence levels. This work improves the agreement of the previous nonrelativistic calculation on *s*→*d* promotion energy with experiment. A table for the energy difference between spin-restricted and spin-polarized 3*d*, 4*d*, and 5*d* atoms is provided that is useful for obtaining the cohesive energy of solids.

37725 Effects of autoionizing resonances on electron-impact excitation rates for transitions among *n*=3 levels in neonlike selenium. Chen, M.H. (High Temperature Physics Division, Lawrence Livermore National Laboratory, Livermore, California 94550 (USA)); Reed, K.J. *Physical Review, A (General Physics) (USA),* 41(9): 4759-4765 (1 May 1990). DOE Contract W-7405-ENG-48.

Direct and resonance excitation rate coefficients have been calculated for transitions between states with principal quantum number n=3 in Ne-like selenium. A relativistic distorted-wave method was used to compute the direct excitation rate coefficients and the resonance excitation rate coefficients were obtained using a multiconfiguration Dirac-Fock method. The effect of autoionizing resonances has been found to be significant for most transitions, especially at low temperatures. The resonances enhance the rate coefficients for some electric-dipole-allowed transitions by as much as a factor of 2. For strongly forbidden transitions, resonances can increase the rate coefficients by more than an order of magnitude.

37726 Mechanisms of double excitation in ion-atom collisions at high velocities. Fritsch, W. (Bereich Physik, Hahn-Meitner-Institut Berlin, D-1000 Berlin 39, West Germany (DE)); Lin, C.D. *Physical Review, A (General Physics) (USA),* 41(9): 4776-4782 (1 May 1990).

Double-excitation cross sections of helium atoms by bare heavy-ion projectiles at high energies are calculated within the one-center atomic-orbital expansion method including the electron-electron interaction between correlated helium wave functions. The resulting excitation cross sections to $2s^2\ ^1S^e$, $2p^2\ ^1D^e$, $2s2p\ ^1P^o$, and $2p^2\ ^1S^e$ states are analyzed. We conclude that double excitations at high energies by low-Z_p projectiles are dominated by a first-order process in which the two-electron transition proceeds through one electron-projectile interaction in conjunction with shakeup or rearrangement due to electron-electron interactions. For high-Z_p projectiles at a given velocity, on the other hand, the excitation is dominated by a second-order process in which the transition proceeds through two successive electron-projectile interactions.

37727 Production of negative hydrogen ions in neutral H+H collisions. Hahn, Y. (Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts 02138 (USA)); Dalgarno, A. *Physical Review, A (General Physics) (USA),* 41(9): 4783-4790 (1 May 1990).

A formulation of collision theory is presented to analyze the process by which H^- and H^+ ions are produced from charge exchange in H(1*s*)+H(1*s*) and H(2*s*)+H(1*s*) collisions in the energy range of 100 eV to 100 keV. A simple closure approximation to the full Green's function allows an analytic evaluation of the amplitudes. The anomalously large cross sections observed experimentally around 0.5 keV, one maximum near 10–20 keV, and the interference feature around 2–4 keV are reproduced, respectively, in the theory by the excitation-exchange amplitude, the direct amplitude, and their interference. The same theoretical procedure is employed in the treatment of both the 1*s* and 2*s* initial projectile states, providing a unified picture of the H+H collision system at low and intermediate energies.

37728 Binary-encounter electrons observed at 0° in collisions of 1–2-MeV/amu H^+, C^{6+}, N^{7+}, O^{8+}, and F^{9+} ions with H_2 and He targets. Lee, D.H. (J. R. Macdonald Laboratory, Kansas State University, Manhattan, Kansas 66506 (USA)); Richard, P.; Zouros, T.J.M.; Sanders, J.M.; Shinpaugh, J.L.; Hidmi, H. *Physical Review, A (General Physics) (USA),* 41(9): 4816-4823 (1 May 1990).

The energy distribution of binary-encounter electrons (BEE) produced in collisions of 1–2 MeV/amu H^+ and bare C, N, O, and F ions with H_2 and He gas targets is reported at 0° with respect to the beam direction. These electrons result from ionization of the target due to hard collisions with the projectile and can thus be considered to be produced in a process analogous to elastic scattering of a free electron from a highly charged ion. An impulse-approximation (IA) model has been developed to describe this process in which "quasifree" target electrons undergo 180° Rutherford scattering in the projectile frame. The measured BEE double-differential production cross sections for bare ions were well described by this model and were found to scale with Z_p^2 and $E_p^{-(\sim 2.6 - -2.7)}$ where Z_p and E_p are the charge and energy of the projectile, respectively. An energy shift of the BEE below 4*t*, where *t* is the cusp electron energy, is observed and is also predicted by the IA treatment. A plane-wave Born approximation (PWBA) calculation for BEE production is also found to be in overall agreement with our data. However, the energy shift of the BEE peak could not be fully accounted for within this PWBA calculation.

37729 Excitation of atomic hydrogen by fully stripped ions. Reinhold, C.O. (Department of Physics, University of Missouri-Rolla, Rolla, MO (USA)); Olson, R.E.; Fritsch, W. *Physical Review, A (General Physics) (USA),* 41(9): 4837-4842 (1 May 1990).

Excitation of atomic hydrogen in initial quantum levels n_i=1,2,3 colliding with multiply charged ions with charge states q from 1 to 26 is investigated in the impact energy range 10 (keV/u)/n_i^2–10 MeV/u, by means of the classical trajectory Monte Carlo, many-state atomic orbital close-coupling, and symmetric eikonal formalisms. This extensive compilation of theoretical calculations confirms the feasibility of an empirical scaling relation (σ/q vs E/q) proposed in previous works to reduce the excitation cross sections induced by multiply charged ions to a single universal curve. This scaling, together with the semiempirical formula derived by Lodge and co-workers [J. Phys. B 9, 239 (1976)] for proton projectiles, is found to provide reliable excitation cross sections for the one-electron collision system. Good agreement is obtained between theory and experiment for proton impact on H(1*s*) at impact energies above 10 keV.

37730 Growth of parametric fields in (2+1)-photon laser ionization of atomic oxygen. Riley, M.E. (Sandia National Laboratories, Albuquerque, New Mexico 87185 (USA)). *Physical*

Review, A (General Physics) (USA), 41(9): 4843-4856 (1 May 1990). DOE Contract AC04-76DP00789.

The multiphoton excitation of an atom by a strong pulsed laser field creates a transient inversion of the pumped, excited level with respect to a lower-lying intermediate level. This results in a coupled time-and-distance traveling-wave situation appropriate for the growth of auxiliary radiation fields that are coupled to the excited, intermediate, and ground levels. Under certain circumstances these fields can suppress the multiphoton excitation process. The two-photon pumping of a ground ^3P level of O to the first excited ^3P level and ionization to the continuum by the same field are analyzed for the growth of amplified spontaneous emission and parametric four-wave mixing. A threshold growth condition is used to interpret the numerical solutions of the appropriate Maxwell-Bloch equations. A novel transition from exponential to linear growth of the parametric waves is observed in the calculations.

37731 Charge transfer and electron detachment for collisions of H^- and D^- with H. Huels, M.A. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185 (USA)); Champion, R.L.; Doverspike, L.D.; Wang, Y. *Physical Review, A (General Physics) (USA),* 41(9): 4809-4815 (1 May 1990).

Total cross sections for charge transfer and electron detachment for collisions of H^- and D^- with atomic hydrogen have been separately determined for collision energies that range from a few electron volts up to several hundred electron volts. The experiments are performed with an apparatus that utilizes a crossed-beam configuration with a radio-frequency discharge as the source of atomic hydrogen. The experimental results are compared with several calculations and with other measurements that overlap the present results at the highest collision energies.

37732 Magnesium atoms in an intense nonresonant laser field. Kim, D. (Department of Chemistry, Brookhaven National Laboratory, Upton, NY (USA)); Fournier, S.; Saeed, M.; DiMauro, L.F. *Physical Review, A (General Physics) (USA),* 41(9): 4966-4973 (1 May 1990). DOE Contract AC02-76CH00016.

A spectroscopic study on the nonresonant multiphoton ionization of magnesium atoms in a high-intensity laser field is reported. Both 0.532- and 1.06-μm radiation in the intensity regime of 10^{10}–10^{13} W/cm^2 are used to produce both singly and doubly ionized magnesium ions. Mass and angularly resolved electron-energy analyses were used in an attempt to gain insight into the dominant mechanisms responsible for ionization. An analysis is presented for intensity- and frequency-dependent results, and electron angular distributions are reduced in terms of atomic parameters derivable from lowest-order perturbation theory. The results demonstrate the important influence that the details of the atomic structure have in describing the high-field nonresonant ionization of magnesium.

37733 Laser effects in photoionization. II. Numerical solution of coupled equations for atomic hydrogen. LaGattuta, K.J. (Applied Theoretical Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (USA)). *Physical Review, A (General Physics) (USA),* 41(9): 5110-5116 (1 May 1990).

The time-dependent Schroedinger equation was solved numerically, as a set of coupled equations, for an electron moving in three spatial dimensions, bound initially in the ground state of a hydrogen atom, and acted upon by a linearly polarized, single-frequency, classical electromagnetic field, turned on abruptly at t=0. Characteristic photoionization times τ_{PI} were computed for a wide range of laser intensities, at a photon energy of 5 eV. Comparison was made with the predictions of two widely used analytic expressions for τ_{PI}. Emitted electron energy spectra and angular distributions were computed. The spectrum of radiation emitted during ionization was also determined.

37734 Precision spectroscopy of n=3 to n=2 transitions in Li-like and Be-like xenon. Simionovici, A. (High Temperature Physics Division, Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550 (USA)); Dietrich, D.D.; Leneman, D.; Grandin, J.P. *Physical Review, A (General Physics) (USA),* 41(9): 5250-5253 (1 May 1990). DOE Contract W-7405-ENG-48.

Energies of the n=3 to n=2 transitions in Li-like and Be-like xenon were measured on the Grand Accelerateur National d'Ions Lourds at Caen, France, using the Lawrence Livermore National Laboratory high-resolution dual-crystal spectrometer. These measurements, on the highest available Z atom, cover the 5.0–5.5-keV energy region with precisions on the order of 150 ppm. Original theoretical results based on the multiconfiguration Dirac-Fock and relativistic many-body perturbation theory methods are shown for comparison.

37735 Multiphoton ionization of magnesium with configuration-interaction calculations. Tang, X. (Department of Physics, University of Southern California, Los Angeles, California 90089-0484 (USA)); Chang, T.N.; Lambropoulos, P.; Fournier, S.; DiMauro, L.F. *Physical Review, A (General Physics) (USA),* 41(9): 5265-5268 (1 May 1990). DOE Contract FG03-87ER60504 ;AC02-76CH00016.

A simple configuration-interaction calculational procedure with a finite-L^2-basis set constructed from B splines is presented and applied to a multiphoton ionization process. An initial application of this theoretical procedure to the four-photon nonresonant ionization Mg at 532 nm has led to excellent agreement with the experimental photoelectron angular distribution measurement. The atomic structure effects due to the multielectron interactions are also examined in detail.

37736 Recombination and dissociation of H_2^+ and H_3^+ ions on surfaces to form $H_2(v'')$: Negative-ion formation on low-work-function surfaces. Hiskes, J.R. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550 (USA)); Karo, A.M. *Journal of Applied Physics (USA),* 67(11): 6621-6632 (1 Jun 1990). DOE Contract W-7405-ENG-48.

The recombination and dissociation of H^+_2 and H^+_3 ions incident upon metal surfaces leads to H, $H_2(v'')$, and H^- products rebounding from the surface. A four-step model for H^+_2 -ion recombination generates $H_2(v'')$ via resonant electron capture through the $b\,^3\Sigma^+_u$ and $X\,^1\Sigma^+_g$ states. A molecular trajectory analysis provides final-state $H_2(v'')$ distributions for incident energies of 1, 4, 10, and 20 eV. The calculated H_2:H^+_2 yields compare favorably with the observed yields. A similar four-step model for incident H^+_3 proceeds via resonant capture to form the $H_3(2p\,^2E' \rightarrow 2p\,^2A_1)$ ground state, in turn dissociating into $H+H_2(v'')$, with the fragment molecule rebounding to give the final $H_2(v'')$ distribution. Comparing the final populations $v'' \geq 5$ for incident H^+_2 or H^+_3 shows that the H^+_3 ion will be more useful than H^+_2 for H^- generation via dissociative attachment. Molecular ions incident upon low-work-function surfaces generate additional $H_2(v'')$ via resonant electron capture through excited electronic states and provide two additional sources of H^- production: Direct H^- production by H dissociation products rebounding from the surface and H^- production through the formation of H^-_2 in the surface selvage that in turn dissociates into $H+H^-$.

37737 Tunneling of molecules in low-temperature media: An elementary description. Silbey, R. (Massachusetts Institute of Technology, Cambridge (USA)); Harris, R.A. *Journal of Physical Chemistry (USA),* 93(20): 7062-7071 (5 Oct 1989).

The authors discuss the influence of the environment on the tunneling of molecules at low temperature, using elementary quantum mechanics. We show that even in the gas phase dephasing processes can render the tunneling incoherent and that the tunneling rate due to dephasing is often enormously decreased relative to the unperturbed period. In addition to these effects, in the condensed phase, a renormalization of the effective tunneling matrix element occurs.

37738 Effects of the transition dipole in Raman scattering. Ling, Song (Univ. of Washington, Seattle (USA)); Imre, D.G.; Heller, E.J. *Journal of Physical Chemistry (USA),* 93(20): 7107-7119 (5 Oct 1989).

The authors use the time-dependent theory of Raman scattering to investigate, both semiclassically and quantum mechanically, the effects of nonconstant transition dipoles on Raman excitation profiles and total Raman emission spectra. The system with a single excited electronic state dominating the scattering process is studied. Semiclassical analytic formulas are derived that can be used to obtain information of the transition dipole and the excited-state surface. Depending on the parameters, significant deviations from the

previous works on the Raman scattering, where the constant transition dipole (Condon approximation) was invoked, are observed.

6404 Fluid Physics

Refer also to citation(s) 38055, 38061

37739 (LA–11821-MS) **Spectral transport model for turbulence.** Besnard, D.C.; Harlow, F.H.; Rauenzahn, R.M.; Zemach, C. Los Alamos National Lab., NM (USA). Jul 1990. 71p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. Order Number DE90011265. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The spectrum of inhomogeneous turbulence is modeled by an approach that is not limited to regimes of large Reynolds numbers or small mean-flow strain rates. In its simplest form and applied to incompressible flow, the model depends on five phenomenological constants defining the strength of turbulence coupling to mean flow, turbulence transport in physical and wave-number space, and mixing of stress-tensor components. The implications for homogeneous turbulence are investigated in detail and found to correspond well to the conclusions from more fundamental theories. Under appropriate limiting conditions, a turbulent system described by the model will relax over time into a state of approximate spectral equilibrium, permitting a reduction to a "one-point" model for the system that is substantially like the familiar K–ϵ model. This yields estimates of the present model's parameters and points to the way to improve modeling of flows beyond the applicability of the K–ϵ method. 38 refs., 1 figs.

37740 (LA-UR–90-1589) **A lattice gas model for thermohydrodynamics.** Chen, Shiyi; Chen, Hudong; Doolen, G.D.; Gutman, S.; Lee, M. Los Alamos National Lab., NM (USA). 3 May 1990. 32p. Sponsored by U.S. DOE Management & Administration; National Aeronautics and Space Administration. DOE Contract W-7405-ENG-36. Grant NAGW-1648. (CONF-8906332–1: Dynamics of concentrated systems conference, Los Alamos, NM (USA), 13-15 Jun 1989). Order Number DE90011964. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The FHP lattice gas model is extended to include a temperature variable in order to study thermohydrodynamics. The compressible Navier-Stokes equations are derived using a Chapman-Enskog expansion. Heat conduction and convention problems are investigated, including Benard convention. It is shown that the usual FHP rescaling procedure can be avoided by controlling the temperature. 20 refs., 12 figs.

37741 (ORNL/FTR–3071) **[Discrete kinetic theory, lattice gas dynamics and foundations of hydrodynamics]: Foreign trip report, September 17–October 2, 1988.** Protopopescu, V. Oak Ridge National Lab., TN (USA). 7 Oct 1988. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012356. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler participated successively in the Workshop of Discrete Kinetic Theory, Lattice Gas Dynamics and Foundations of Hydrodynamics, Villa Gualino-Torino, Italy, and in the Third International Workshop on Mathematical Aspects of Fluid and Plasma Dynamics, Salice Terme-Pavia, Italy, as a guest of the Italian CNR (National Council for Research, Mathematical Physics Group). At the first Workshop, there were approximately 65 participants among whom 35 were speakers. The topics discussed were discrete kinetic theory, cellular automata, and the relationship between microscopic/mesoscopic and macroscopic evolution equations. Cellular automata and lattice gas dynamics emerged as main areas of promising research and future applications. At the second Workshop, there were approximately 80 attendants, 20 contributed papers, and 15 invited papers. The main subjects of the papers were general methods to study nonlinear equations, advances in plasma theory, numerical methods, efficient computational schemes, and nonlinear transport problems. The Italian scientists expressed interest in strengthening the collaboration with ORNL in the areas of nonlinear partial differential equations, and discrete dynamics with applications to competitive systems.

37742 Perturbation growth by thermal blooming in turbulence. Karr, T. (Lawrence Livermore National Laboratory, P.O. Box 808, L-495, Livermore, California 94550 (US)); Morris, J.; Chambers, D.; Viecelli, J.; Cramer, P. *Journal of the Optical Society of America, Part B: Optical Physics (USA),* 7(6): 1103-1124 (Jun 1990). DOE Contract W-7405-ENG-48.

The stability of a phase-compensated laser beam propagating in a turbulent absorbing fluid is considered. Small-scale transverse optical perturbations caused by turbulence and noise grow in thermal blooming by two instabilities: the uncompensated stimulated thermal Rayleigh scattering instability and the closed-loop instability. Linearized perturbation theory is used to calculate the electric field spectrum as a Taylor series in time and as a superposition of stable and unstable modes. The method is applicable to fluids with arbitrary parameter variations along the path. Compensated perturbations grow exponentially, and uncompensated ones grow quasi-exponentially. The instability growth rates and the turbulence and noise excitation strengths are derived for a simple fluid with homogeneous parameters. The linearized theory of perturbation growth is in good agreement with numerical simulations of full nonlinear thermal blooming. If the growth rate exceeds the damping rate from other phenomena, then the perturbations grow until they are limited by nonlinear saturation, at which point the beam is significantly degraded. At saturation the laser beam spontaneously breaks into small-scale transverse structures such as filaments or ribbons. The strongest damping mechanism in the open air is typically wind shear, which sets a threshold blooming rate and a threshold absorbed irradiance. Below threshold the perturbations grow linearly; above threshold they grow quasi-exponentially. Other atmospheric damping phenomena, such as diffusion and turbulent mixing, have a smaller effect.

37743 Chaotic mixing as a renormalization-group fixed point. Glimm, J. (Department of Applied Mathematics and Statistics, State University of New York at Stony Brook, Stony Brook, New York 11794-3600 (USA)); Sharp, D.H. *Physical Review Letters (USA),* 64(18): 2137-2139 (30 Apr 1990). DOE Contract FG02-88ER25053.

A renormalization-group fixed point is found, corresponding to chaotic mixing in the Rayleigh-Taylor instability problem. The outer envelope of the mixing region, adjacent to the heavy fluid, is dominated by a merger of unstable modes (bubbles of light fluid) and dynamically changing length scales. A statistical model is introduced as an approximation to the full two-fluid Euler equation to describe the mixing envelope. Molecular-chaos and continuous-time approximations to this model define an approximate renormalization-group equation, which is shown to have a nontrivial fixed point.

37744 Quantum turbulence. Davis, R.L. (Institute for Advanced Study, Olden Lane, Princeton, New Jersey 08540 (US)). *Physical Review Letters (USA),* 64(21): 2519-2522 (21 May 1990). DOE Contract AC02-76ER02220.

Quantum turbulence in an antisymmetric-tensor model of superfluids at zero temperature is an effect analogous to vacuum polarization in electrodynamics: it is due to a quantum-mechanical instability in the presence of a strong background field. In place of pair creation there is the spontaneous formation of expanding loops of vorticity. The phenomenon can be described by a linear theory of vortices interacting with a two-index antisymmetric-tensor potential, much like electrodynamics. The rate at which turbulence sets in is estimated for supersonic flow and flow around a wedge. It is argued that turbulence and renormalization of the string mass per unit length are closely related.

37745 Relationship between permeability and diffusion-controlled trapping constant of porous media. Torquato, S. (Department of Mechanical and Aerospace Engineering, North Carolina State University, Raleigh, North Carolina 27605-7910 (USA)). *Physical Review Letters (USA),* 64(22): 2644-2646 (28 May 1990). DOE Contract FG05-86ER13482.

For anisotropic porous media of arbitrary topology, it is shown that there exists a rigorous relation between the fluid permeability tensor $\mathbf{k}$ and the diffusion-controlled trapping constant γ, namely, $\mathbf{k} \leq \gamma^{-1}\mathbf{I}$. It is demonstrated that the equality is achieved for a certain class of microstructures and that the bound can be relatively

sharp for other media. The important fundamental as well as practical implications of this relation are discussed.

37746 Thermal fluctuations and phase equilibrium in microemulsions. Golubovic, L. (Department of Physics, University of California, Los Angeles, Los Angeles, CA (USA)); Lubensky, T.C. *Physical Review, A (General Physics) (USA)*, 41(8): 4343-4366 (15 Apr 1990). DOE Contract FG03-88ER45378.

We construct a simple coarse-grained model and use it to study global phase behavior of ensembles of fluid membranes. This model is an improvement over previous phenomenological models of Talmon and Prager, de Gennes and co-workers, Widom, and more recently of Safran and co-workers. We show here that there is necessarily an entropic contribution, missing in all previous theories, to the coarse-grained free energy whose physical origin is the same as that of Helfrich's entropic repulsion stabilizing lamellar multimembrane phases. The inclusion of this steric entropy in the previous phenomenological studies is essential if they are to be used in the study of periodic phases in microemulsions and analogous surfactant systems. Thus the model enables us to obtain, in a unified way, phase diagrams containing both uniform and periodic phases in microemulsions and in binary systems of nonionic surfactant bilayers in a single solvent. Mean-field theory for this model yields rich phase diagrams containing dilute, random bicontinuous, lamellar, columnar, and an antiferromagnetic phase that may correspond to a droplet crystal or to a "plumber's nightmare." The model depends on two phenomenological parameters related to strengths of steric entropy and softening of membrane rigidity. We discuss the sensitivity of phase diagrams (in particular the existence of the middle-phase microemulsion) to values of these parameters. We find that the existence of a realistic middle phase (with structural length scale much larger than the molecular length scale) crucially depends on the presence of steric entropy. The model reproduces the experimentally observed four-phase equilibria among uniform phases in microemulsions.

37747 Properties of confined states in phase dynamics. Brand, H.R. (Fachbereich 7, Physik, Universitaet Essen, D-4300 Essen 1, (West Germany)— Theoretische Physik, Universitaet Bayreuth, D-8580 Bayreuth, (West Germany)— Center for Nonlinear Studies, MS-B 258, Los Alamos National Laboratory, University of Calif *Physical Review, A (General Physics) (USA)*, 41(10): 5478-5481 (15 May 1990).

In this paper we point out that for the confined states discussed recently for the phase associated with a stationary pattern, a conservation law for both the phase variation and the local wave vector exists. We discuss the physical implications of this observation as a function of the imposed boundary conditions. We investigate the influence of noise and we find that for the phase change and for the local wave vector, the stationary solution of the associated functional differential Fokker-Planck equation can be explicitly given.

37748 Thermal diffuse x-ray-scattering studies of the water-vapor interface. Schwartz, D.K. (Department of Physics and Division of Applied Sciences, Harvard University, Cambridge, Massachusetts 02138 (USA)); Schlossman, M.L.; Kawamoto, E.H.; Kellogg, G.J.; Pershan, P.S.; Ocko, B.M. *Physical Review, A (General Physics) (USA)*, 41(10): 5687-5690 (15 May 1990). DOE Contract AC02-76CH00016.

Agreement between the theoretical and measured resolution dependence of x-ray specular reflection from the H_2O-vapor interface shows that the macroscopic capillary model for surface roughness can be extended to length scales as small as 400 A. Agreement between measured thermal diffuse scattering data and the theoretical form, with *no significant adjustable parameters*, independently leads to similar conclusions.

37749 Deep-inelastic neutron scattering from liquid ^{4}He. Sosnick, T.R. (Intense Pulsed Neutron Source, Argonne National Laboratory, Argonne, Illinois 60439 (USA)); Snow, W.M.; Sokol, P.E. *Physical Review, B: Condensed Matter (USA)*, 41(16): 11185-11202 (1 Jun 1990). DOE Contract W-31-109-ENG-38.

Deep-inelastic neutron scattering measurements on liquid ^{4}He have been carried out for temperatures from 0.35 to 4.2 K at a density of 0.147 g/cm^3. These measurements have a relative resolution comparable to previous reactor measurements, but at a momentum transfer of 23 A^{-1}. This momentum transfer is sufficiently high that the differences between the observed scattering and that predicted by the impulse approximation are small and are well described by a recent theoretical treatment allowing direct information on the single-particle momentum distribution to be obtained from the scattering measurements. The scattering in the normal liquid phase is broad and featureless with a nearly Gaussian shape. The scattering in the superfluid phase is distinctly non-Gaussian with extra intensity at the peak center consistent with the presence of a Bose condensate. However, no distinct peak due to the Bose condensate is observed even when the effects of instrumental broadening are included. When deviations from the impulse approximation are taken into account using a recent theory, the experimental results at 0.35 K are in excellent agreement with *ab initio* ground-state variational and Green's-function Monte Carlo calculations in the superfluid at T=0 K. The results at higher temperatures are in excellent agreement with recent path-integral Monte Carlo calculations in both the normal and superfluid phases. Fits of model functions to the scattering are also presented. The average kinetic energy per atom has been determined and is in good agreement with theoretical predictions and with previous experimental results.

37750 Three-dimensional random *XY* model: Application to the superfluid transition of ^{4}He in porous media. Li, Y. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627 (US)); Teitel, S. *Physical Review, B: Condensed Matter (USA)*, 41(16): 11388-11391 (1 Jun 1990). DOE Contract FG02-89ER14017.

We study a three-dimensional classical *XY* model with strongly fluctuating, spatially uncorrelated, bond disorder. Finite-size scaling analysis of Monte Carlo simulation data has been used to determine critical exponents. Evidence for a possible shift in exponents from the pure *XY* case is found. Connection to recent experiments on the superfluid phase transition of ^{4}He in porous media is discussed.

6450 High Energy Physics

Refer also to citation(s) 37837, 38334

37751 (EP-PNHE-RA–1988) **High energy nuclear physics.** Meyer, J. (CEA, 75 - Paris (FR)). Ecole Polytechnique, 91 - Palaiseau (France). 1988. 29p. (In French). Order Number DE90500843. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the High Energy Nuclear Physics laboratory (Polytechnic School, France), is presented. The Laboratory research program is focused on the fundamental physics of interactions, on the new techniques for the acceleration of charged particles and on the nuclei double beta decay. The experiments are performed on the following topics: the measurement of the π^0 inclusive production and the photons production in very high energy nuclei-nuclei interactions and the nucleon stability. Concerning the experiments under construction, a new detector for LEP, the study and simulation of the hadronic showers in a calorimeter and the H1 experiment (HERA), are described. The future research programs and the published papers are listed.

6451 Particle Interactions and Properties - Experimental

Refer also to citation(s) 37436, 37443, 37825

37752 (CONF-900331–11) **Experimental results concerning global observables from the CERN SPS heavy ion program.** Young, G.R. Oak Ridge National Lab., TN (USA). Jun 1990. 23p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Workshop on heavy ion physics at the alternating gradient synchrotron; Upton, NY (USA); 3-7 Mar 1990. Order Number DE90012285. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A brief overview is given of experimental results obtained during the initial operation of the heavy-ion program at the CERN SPS during the period 1986–1988. This paper confines itself to a presentation of results on so-called global observables, such as

energy flow and multiplicity distributions, and on information extracted from them. Of particular interest among the latter are an estimate of the magnitude and spatial distribution of the energy density attained. 3 refs., 27 figs.

37753 (DOE/ER/03230–T9) **Research in elementary particle physics: Technical progress report, June 1, 1989–May 31, 1990.** Kirsch, L.E.; Schnitzer, H.J.; Abbott, L.F.; Bensinger, J.R.; Blocker, C.A. Brandeis Univ., Waltham, MA (USA). Dept. of Physics. [1990]. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER03230. Order Number DE90013443. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper discusses: CDF analysis; CDF system support; SSC laboratory development; solenoidal detector collaboration program; meson spectroscopy; conformal field theory; wormholes in quantum gravity; neural networks. (FI)

37754 (DOE/ER/40233–5) **Topics in gauge theories and the unification of elementary particle interactions: Progress report, March 1, 1990–February 28, 1990.** Srivastava, Y.N.; Vaughn, M.T. Northeastern Univ., Boston, MA (USA). Feb 1990. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER40233. Order Number DE90013435. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

We report on work done by the principal investigators (Y.N. Srivastava and M.T. Vaughn) and their collaborators on non-scaling phenomena in very high energy, low p_t physics, signatures for excited leptons and quarks, vacuum polarization effects in QED and in the standard model for macroscopic systems, anomalous decays of the Z^0, computer graphic representations of topological solutions to classical field equations, and of iterated maps, and renormalization group analysis of unified gauge theories.

37755 (FNAL/C–90/85-E) **The dijet invariant mass at the Tevatron Collider.** Giannetti, P. (Istituto Nazionale di Fisica Nucleare, Pisa (Italy)). The CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (USA). 9 May 1990. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-9003161–6: 25. Rencontres de Moriond on QCD and hadronic interactions conference, Les Arcs (France), Mar 1990). Order Number DE90012845. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The differential cross section of the process p + pbar → jet + jet + X as a function of the dijet invariant mass has been measured with the CDF detector at a center of mass energy of 1.8 TeV at the Tevatron Collider in Fermilab. The present analysis is based on the sample of events collected in the 1988/89 run, amounting to a total integrated luminosity of 4.2 pb^{-1}. A comparison to leading order QCD and quark compositeness predictions is presented as well as a study of the sensitivity of the mass spectrum to the gluon radiation. 10 refs., 6 figs.

37756 (FNAL/C–90/86-E) **Large P_t jets at CDF.** Dell'Orso, M. (Pisa Univ. (Italy). Dipt. di Fisica). The CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (USA). 9 May 1990. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-9003175–1: Les Rencontres de Physique de la Vallee D'Aosta, La Thuile (Italy), 18-24 Mar 1990). Order Number DE90012846. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The inclusive jet cross section and the dijet mass spectrum have been measured at the Fermilab Tevatron Collider at $\sqrt{s}$ = 1.8 TeV. These measurements span approximately 7 orders of magnitude in cross section and contain jets up to 400 GeV in transverse energy and dijet masses up to 950 GeV. Comparisons have been made to QCD at both orders α_s^2 and α_s^3. 8 refs., 9 figs.

37757 (FNAL/C–90/91-E) **Inclusive jet cross section at $\sqrt{s}$ = 1.8 TeV.** Hessing, T.L. (Texas A and M Univ., College Station, TX (USA). Dept. of Physics). The CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (USA). May 1990. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-9003161–4: 25. Rencontres de Moriond on QCD and hadronic interactions conference, Les Arcs (France), Mar 1990). Order Number DE90012665. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The inclusive jet cross section at $\sqrt{s}$ = 1.8 TeV has been measured at the Fermilab Tevatron Collider. This measurement spans approximately 7 orders of magnitude in cross section and contains jets ranging from 30 GeV to over 400 GeV in transverse energy (E_t). Comparisons have been made to QCD at both order α_s^2 and α_s^3. 5 refs., 3 figs., 2 tabs.

37758 (FNAL/C–90/93-E) **A new limit on the mass of the top quark.** Sliwa, K. (Tufts Univ., Medford, MA (USA)). The CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (USA). May 1990. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-9003161–7: 25. Rencontres de Moriond on QCD and hadronic interactions conference, Les Arcs (France), Mar 1990). Order Number DE90012847. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We present a preliminary result of an extension of our already published search for the top quark. The analysis is based on a data sample recorded during the 1988–1989 run with Collider Detector at Fermilab (CDF), and corresponding to an integrated luminosity of 4.4 pb^{-1}. In addition to the previously studied events with energetic $e^{\pm}\mu^{\mp}$ pairs we have analyzed the two remaining dilepton channels, namely, e^+e^- and $\mu^+\mu^-$. A new search was performed in electron+multijet and muon+multijet events, in which an additional low-transverse-momentum μ was required as a signature of a b-quark jet. No new candidates were found. A combined upper limit on the $t\bar{t}$ cross section, derived from these samples, translates, in the context of the Standard Model, into a limit on the mass of the top quark, $M_t > 89$ GeV/c^2 @ 95% C.L. Top quarks can thus decay into the $W^{\pm}$ + quark final states in which a $W^{\pm}$ is an on-mass-shell particle. 8 refs., 5 figs., 2 tabs.

37759 (FNAL/C–90/100-E) **Dilepton and dihadron production in proton-nucleus collisions at 800 GeV.** Mishra, C.S. The E-772 and 789 Collaborations. Fermi National Accelerator Lab., Batavia, IL (USA). May 1990. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-9003161–5: 25. Rencontres de Moriond on QCD and hadronic interactions conference, Les Arcs (France), Mar 1990). Order Number DE90012664. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A high statistics measurement of the atomic mass dependence of Drell-Yan, J/ψ, ψ' and Υ production induced by 800 GeV protons on deuterium, carbon, calcium, iron and tungsten targets has been performed at FermiLab (E772). The data consist of about 700,000 muon pairs covering the mass region 3 GeV $\leq M_{\mu\mu} <$ 14 GeV. No nuclear modification is seen in the production of massive muon pairs in the Drell-Yan region for $0.1 < x_2 < 0.3$. The relative dimuon yield for fractional antiquark momentum $x_2 < 0.1$ is slightly less than unity for heavy nuclei. J/ψ and ψ' production are strongly suppressed in heavy nuclei. An upgraded version on the spectrometer designed to measure two-body decays of neutral c and b-quark hadrons (E789) will be discussed. 17 refs., 8 figs.

37760 (FNAL/C–90/118-E) **Recent results on direct photons from CDF [Collider Detector at Fermilab].** Harris, R.M. The CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (USA). 1 Jun 1990. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-9004112–2: Workshop on hadron structure functions and parton distributions, Batavia, IL (USA), 26-28 Apr 1990). Order Number DE90012668. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We report on preliminary measurements of direct photons in $\bar{p}p$ collisions at $\sqrt{s}$ = 1.8 TeV from the 1988–89 run of the Collider Detector at Fermilab (CDF). The inclusive direct photon cross section, measured for photon transverse momentum in the range $13 < P_t < 68$ GeV, has an excess at low P_t compared to recent Quantum Chromodynamic (QCD) calculations. The pseudorapidity distribution of the away-side jet, for events with $27 < P_t < 33$ GeV, agrees with QCD predictions. Measurements of the K_t kick in photon-jet events are also presented. 8 refs., 10 figs., 1 tab.

37761 (INS–803) **A proposal to study double-Λ hypernuclei and H-dibaryon by using a 4π-type spectrometer.** Fukuda, Tomokazu. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Dec 1989. 7p. Order Number DE90798930. Available from NTIS (US Sales Only), PC A02/MF A01.

In order to develop physics with S=-2, a new method is proposed to study double-Λ hypernuclei as well as H by using a 4π-type spectrometer, which is expected to be useful in detecting abundant double-Λ hypernuclei and/or H-dibaryon. It is proposed to replace the emulsion with a vertex detector of medium spatial resolution and a detector for pion energy measurement. An example of the experimental setup is outlined. High-density material is planned to be used as target, together with two layers of a scintillating-fibre (SF) microvertex detector, surrounded by a 4π-type spectrometer with central drift chamber and an array of neutron counter. The first layer SF detector and the second one will consist of narrow-diameter (30-100 μm) and medium-diameter (500 μm) scintillating fibres. The spatial resolution of this system would be less than 100 μm. Work will be performed to identify double-Λ hypernuclei production as an event involving three prongs in the SF detector (a stopped Ξ^- and two decaying pions). A main background event comes from the process of a Ξ^- p→ Λ Λ quasi free production, followed by a π^- decay of Λ. This process will be largely suppressed by rejecting no or one pion around stopped point of Ξ^- because neutral Λ will produce no signals. The decaying pions are detected by the second layer SF detector and the energy of pions is determined by the range in the SF detector. (N.K.)

37762 (KEK–89-17, pp. 207-239) **B meson decay in LUND 6.3.** Tamai, Kunio (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Nov 1989. (CONF-8910393–: Workshop for asymmetric B-factory at KEK, Tsukuba (Japan), 2-4 Oct 1989). In *Proceedings of the workshop on asymmetric B factory at KEK*. Order Number DE90777869. Available from NTIS (US Sales Only), PC A12/MF A01.

We studied treatments and problems of B meson decays in LUND 6.3 program. The overall features, such as average decay multiplicities, inclusive decay branching fractions etc., are almost consistent with experiment, but the agreements for the exclusive decay are not so good. The magnitude of the signal for some decay with small branching fraction can be different from the experiment by about a factor of 10. The program would be available to estimate overall features of B meson decay. (author).

37763 (LA–11877-C) **Lectures from the workshop on nucleon-nucleon bremsstrahlung, January 25–26, 1990.** Gibson, B.F.; Schillaci, M.E.; Wender, S.A. (comps.). Los Alamos National Lab., NM (USA). Jul 1990. 95p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-900179–Summs.: Los Alamos National Laboratory (LANL) workshop on n-p Bremsstrahlung, Los Alamos, NM (USA), 25-26 Jan 1990). Order Number DE90012740. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The Nucleon-Nucleon Bremsstrahlung Workshop was convened at LAMPF on 25–26 January 1990 in order to review the theoretical and experimental aspects of that reaction with focus on a possible new initiative to measure neutron-proton bremsstrahlung using the intermediate-energy, white-spectrum neutron source at the LAMPF/WNR facility. Over the course of this intense day-and-a-half workshop, experts in the field established the historical perspective for both theory and experiment, presented result of recent calculations, and examined new approaches to the difficult neutron-proton bremsstrahlung experiment. Theoretical and experimental working groups generated recommendations for action and actually converged upon a plan for an experimental program, not just a single measurement.

37764 (LAL–88-05) **Study of the J/Ψ decay into five pions.** Augustin, J.E. (Paris-11 Univ., 91 - Orsay (FR). Lab. de l'Accelerateur Lineaire); Cosme, G.; Couchot, F.; Fulda, F.; Grosdidier, G.; Jean-Marie, B.; Lepeltier, V.; Mane, F.; Szklarz, G.; Bisello, D. DM2 Collaboration. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Dec 1988. 24p. Order Number DE90500804. Available from NTIS (US Sales Only), PC A03/MF A01.

A high statistics study of the J/Ψ $\pi^+ \pi^- \pi^+ \pi^- \pi^0$ decay is performed from the 8.6 million J/Ψ observed by the DM2 experiment at DCI. ρ and ω associated production is evidenced and branching ratios for pa_2 (1320), inclusive ω $\pi^+ \pi^-$, ωf_2 (1270) and $b_1^{\pm}$ (1235)π^{-+} dynamics are given. In the ω $\pi^+ \pi^-$ final state a bump is observed at a low ($\pi^+ \pi^-$) mass and a possible ωf_0 (975) contribution is discussed. Moreover first measurement of J/Ψ → ω $\pi^0 \pi^0$ is reported and branching ratios for this decay and for ωf_2 (1270) and b_1 (1235)π^0 dynamics are given. Evidence is found of the low ($\pi \pi$) mass bump observed in the charged mode.

37765 (LAL–88-25) **The J/Ψ → vector+pseudoscalar decays and the η, η′ quark content.** Augustin, J.E. (Paris-11 Univ., 91 - Orsay (FR). Lab. de l'Accelerateur Lineaire); Cosme, G.; Couchot, F.; Fulda, F.; Grosdidier, G.; Jean-Marie, B.; Lepeltier, V.; Mane, F.; Szklarz, G.; Jousset, J. DM2 Collaboration. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Dec 1988. 33p. Order Number DE90500816. Available from NTIS (US Sales Only), PC A03/MF A01.

Branching ratios of J/Ψ decays into ω π^0, ω η, ω η′, ρ η, ρ η′, φ η, φ η′ and K* (892) anti K + c.c. are measured from the 8.6 million J/Ψ produced by the DM2 experiment at DCI. The η and η′ mesons are found consistent with a q anti q structure and a mixing angle $\theta_p = (-19.1 \pm 1.4)^0$.

37766 (LAL–88-51) **New DM2 results on D/f_1(1285) and ι/η(1440).** Stanco, L. DM2 Collaboration. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Nov 1988. 12p. (CONF-880862–: BNL workshop on glueballs, hybrids and exotic hadrons, Upton, NY (USA), 29 Aug - 1 sep 1988). Order Number DE90500809. Available from NTIS (US Sales Only), PC A03/MF A01.

Preliminary results from Partial Wave Analysis on the D/f_1(1285) mass region in the J/Ψ → γ4 $\pi^{\pm}$ decay and on the ι/η(1440) region in the J/Ψ γK antiK π decays are presented. In the first channel the PWA excludes a η(1275) contribution, so supporting the f_1 identification for the observed peak. A clear pseudoscalar signal is evidenced in the K anti K π mass spectrum decaying via δ/a_0(980) as well as K* (892) dynamics. Its width is smaller than in the total spectrum, two other contributions, a narrow (less than 30 MeV/c^2) 1^{++} peak at 1395 MeV/c^2 which decays into δ π and a shoulder at 1515 MeV/c^2 observed in the direct 3-body decay K anti K π, being present. This last state might have a spin-parity 1^{++} even if within large statistical limitations.

37767 (LAL–88-56) **First evidence for direct Cp violation.** Schaffer, A. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Dec 1988. 7p. (CONF-8808145–: 4. meeting of the Division of Particles and Fields of the American Physical Society (APS), Storrs, CT (USA), 15-18 Aug 1988). Order Number DE90500793. Available from NTIS (US Sales Only), PC A02/MF A01.

A three standard deviation nonzero measurement of ϵ'/ϵ is discussed, with emphasis on the systematic error and future improvements.

37768 (LAL–88-58) **The π, K, proton electromagnetic form factors and new related DM2 results.** Castro, A. DM2 Collaboration. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Dec 1988. 23p. (CONF-8810407–: Nuclear structure workshop, Frascati (Italy), 27-28 Oct 1988). Order Number DE90500807. Available from NTIS (US Sales Only), PC A03/MF A01.

The DM2 results on the pion, kaon and proton form factors are reviewed. Preliminary results on e^+e^- Λ antiΛ, Λ antiΣ^0, Σ^0 antiΣ^0 and e^+e^- n anti n are given.

37769 (LAL–89-10) **Selected topics from NA14': charm production and new results on D_s decays.** Wormser, G. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. May 1989. 5p. (CONF-8903175–: 24. Recontre de Moriond conference, Les Arcs (France), 12-17 Mar 1989). Order Number DE90500788. Available from NTIS (US Sales Only), PC A02/MF A01.

NA14' is a charm photoproduction experiment, using a 100 GeV photon beam produced by the CERN SPS. Its set-up combines a high precision Silicium microvertex detector with a large acceptance spectrometer for both charged and neutral tracks. Production cross-sections are reported for various charmed particles. Our data are well reproduced by the photon gluon fusion model and the Lund hadronization scheme except A_c production which is found to be in

excess over the predictions. Search for Ds decays in the mode $D_S \rightarrow \eta' \pi$ and $D_S \rightarrow \phi \pi \pi^0$ are reported. A clear evidence is found for the former decay, with a preliminary branching ratio $BR(D_S \rightarrow \eta' \pi)/BR(D_S \rightarrow \phi \pi) = 6.9 \pm 2.4 \pm 1.4$. An upper limit is given for the latter decay $BR(D_S \rightarrow \phi \pi \pi^0)/BR(\phi \pi) < 2.5$. Those 2 results are incompatible with theoretical expectations, where the first decay was supposed to be small and the second much larger.

37770 (LAL–89-19) **The search of the top quark in the UA2' experiment.** Buskulic, D. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire; Paris-6 Univ., 75 (France). May 1989. 193p. (In French). Order Number DE90500875. Available from NTIS (US Sales Only), PC A09/MF A01.

We present in this thesis a preliminary analysis of the data accumulated in 1988 by the UA2' experiment at the SpantipS collider at CERN, at the centre-of-mass energy of 630 GeV. The integrated luminosity for this study is 2.5 pb^{-1}. It's aim is to search for a top quark, in the decay channel top giving b+electron+neutrino, producing a high transverse momentum electron and neutrino accompanied by two (proton-antiproton – W – top-antibottom pair) to four (proton-antiproton – top-antitop pair) jets. Two studies have been performed: one with the accent on the good measurement of missing transverse momentum in UA2', requiring it to be above 15 GeV/c, is sensitive to top quark masses between 40 and 65 GeV/c^2; the other, with the accent rather on the excellent electron identification power of UA2', is sensitive to top quark masses between 30 and 50 GeV/c^2. A detailed study of the various background processes (W+2jets, bottom-antibottom, QCD background) is also presented, followed by a preliminary discussion of the systematic errors on the various predictions. No signal was observed for top quark masses between 30 and 60 GeV/c^2.

37771 (LAL–89-20) **Present status of the NA31 experiment.** Auge, E. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. May 1989. 8p. (CONF-8903175–: 24. Recontre de Moriond conference, Les Arcs (France), 12-17 Mar 1989). Order Number DE90500789. Available from NTIS (US Sales Only), PC A02/MF A01.

The NA31 collaboration has taken new data in order to improve its previous measurement of $Re(\epsilon'/\epsilon)$, which remains the only experimental evidence for Direct CP Violation. The analysis of the new data is in progress, and we present evidence that the systematic uncertainty will be substantially smaller than on the old result. In a separate run, data have been taken in order to measure the phase difference: $\Delta \Phi = \Phi_{00} - \phi_{+-}$. This tests the conservation of CPT in K^0decays. A preliminary result is compatible with $\Delta \Phi = 0$.

37772 (LAL–89-21) **Selected topics on B physics at Lep.** Roudeau, P. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. May 1989. 17p. (CONF-8903175–: 24. Recontre de Moriond conference, Les Arcs (France), 12-17 Mar 1989). Order Number DE90500791. Available from NTIS (US Sales Only), PC A03/MF A01.

I will consider mainly those aspects of B physics which are peculiarly relevant at LEP. I will envisage two scenarios for LEP operation: the standard one with the nominal luminosity and also a high luminosity run during which more than 10^8 hadronic Z^0 decays can be registered.

37773 (LA-UR–90-1783) **A search for $\mu \rightarrow e\gamma$ at the level of 10^{-13}.** Amann, J.F.; Black, K.; Bolton, R.D.; Carius, S.; Cooper, M.D.; Foreman, W.; Hansen, C.; Harrison, R.; Hart, G.; Hart, V. Los Alamos National Lab., NM (USA). [1990]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-900822–1: 25. IUPAP international conference on high energy physics, Singapore (Singapore), 2-8 Aug 1990). Order Number DE90012058. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The status of the MEGA experiment is described. It is a search for the decay $\mu \rightarrow e\gamma$ with a branching ratio sensitivity of approximately 10^{-13}. The observation of this decay would indicate the existence of physics outside the standard model of electroweak interactions. The experiment employs highly modular, fast detectors, state-of-the-art electronics, and a staged trigger with on-line filters. The detectors are contained in a 1.5 T solenoidal field produced by a superconducting magnet. Positrons are confined to the central region and are measured by a set of thin MWPCs. Photons are measured by one of four layers of pair spectrometers in the outer region. Most aspects of the detector design have been validated in engineering runs; data taking will begin in 1990 with most of the electron arm and one pair spectrometer layer installed. 5 refs., 4 figs.

37774 (LPHNEP–88-09) **The measurability, by means of the DELPHI detector, of the Z^0 mass and width from the $e^+e^- \rightarrow \mu^+\mu^-\gamma_1...\gamma_n$ (muons) reaction.** Brault, L. Paris-11 Univ., 91 - Orsay (France). 1988. 140p. (In French). Order Number DE90500818. Available from NTIS (US Sales Only), PC A07/MF A01.

To estimate the performances of DELPHI detector we first studied the triggering process including the Outer Detector (OD), and then extracted the Z^0 mass and width from the process electron positron → muons + soft photons. The implementation, on the acquisition boards of OD, of a dedicated treatment for the plank edges makes the fast trigger efficiency go from 93% up to 99.7%. For the T3 phase of acquisition we developed, for OD, a fast algorithm that gives track elements to the decision processor, those being computed from raw data. The program was tested on a 68000 microprocessor cadenced at 8MHz. The results were satisfactory: a track candidate is treated in 1ms. To study the muons + soft photons channel we developed a Monte Carlo which generates events with multiple soft photons: MUSOFT. We designed a procedure that discriminates between soft and hard events. If one takes into account the Poisson fluctuations and the behavior of the discrimination, one obtains the following results: error in Z^0 mass (MeV/c2)=29.0 error in Z^0 width (MeV/c2)=58.7.

37775 (LPNHEP–88-08) **Electromagnetic radiative corrections at LEP-SLC energies for experimentalists.** Campagne, J.E. (Paris-6 Univ., 75 (France). Lab. de Physique Nucleaire et de Hautes Energies); Zitoun, R. Paris-6 Univ., 75 (France). Lab. de Physique Nucleaire et de Hautes Energies. 1988. 21p. Order Number DE90500794. Available from NTIS (US Sales Only), PC A03/MF A01.

Using the formalism of structure functions, we have constructed an event generator, called DYMU2. It should meet the required precision for the measurement of the Z^0 parameters in the first generation experiments at LEP-SLC by incorporating full second order radiative corrections in the initial state and first order exponentiation in the final state. The effect of interference terms between initial state is discussed.

37776 (LPNHEP–89-02) **Study of the muonic channel of $e^+e^- \rightarrow \mu^+\mu^-(\gamma)$ for the DELPHI experiment: radiative corrections and performance of trigger and reconstruction systems.** Campagne, J.E. Paris-6 Univ., 75 (France). Lab. de Physique Nucleaire et de Hautes Energies; Paris-6 Univ., 75 (France). May 1989. 115p. (In French). Order Number DE90500776. Available from NTIS (US Sales Only), PC A06/MF A01.

The muonic decay channel of the Z^0 is chosen for its simplicity rather than its rate. The advantage of this channel is to reduce theoretical uncertainties of higher order beyond the Born approximation. However it has the drawback of raising specific problems from low multiplicity events for the DELPHI trigger and reconstruction systems. The first aspect of my work consisted in showing that compact formulae exist, and are good tools for extracting Z^0 parameters from corrected cross-section and forward-backward asymmetry data. The second aspect was to design an event generator called DYMU2 with the aim of determining the DELPHI trigger and reconstruction efficiencies. The study of the outer (OD) and inner (ID) detectors correlation yield an estimated rate of 99.4% for the first level barrel track trigger and of 98.4% for the second level. Taking into account the results of the muon trigger, we expect a trigger efficiency larger than 99%. The processing of 8000 events through the complete DELPHI analysis chain yields a reconstruction efficiency around 80%, rather unsensitive to the total energy.

37777 (MPI-PAE/Exp.El.–222) **Production and decay of the τ lepton.** Scholz, S. Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik; Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik. Feb 1990. 146p. (In German). Order Number

DE90501236. Available from NTIS (US Sales Only), PC A07/MF A01.

With the CELLO detector at the storage ring PETRA at a c.m. energy of $\sqrt{s}$=35 GeV production and decay of the τ lepton were studied. For the production of τ pairs in the e^-e^+-annihilation the cross section and the charge asymmetry were measured. For the decay of the τ lepton for the first time all exclusive and the topological branching ratios were measured simultaneously. Most of the measured exclusive branching ratios were determined with the highest hitherto reached precision of a single measurement and agree generally well with the hitherto world mean values. For the decays $\tau^-\rightarrow e^-$anti $\nu_e\nu_\tau$, $\tau^-\rightarrow\pi^-\pi^0\nu_\tau$ and $\tau^-\rightarrow\pi^-\pi^+\pi^-\nu_\tau$ however branching ratios were measured, which lie 1-2 standard deviations above the world mean values. The measurement of the topological branching ratios BR_1 respectively BR_3 yielded by 2 standard deviations lower respectively higher values than the world average. While the sum of all exclusive branching ratios from the hitherto measurements exhibit a deficit of $\simeq$6% missing decays, the results of this measurement sum up to 99.3% and let therefore few space for unknown decay modes of the τ lepton. Contrarily to the world mean values especially the topological 1-prong branching ratio agrees with the sum of the exclusive decay rates. The branching ratio into decays, which are not predicted by the standard model, could by intensive systematic studies on the completeness of the analyzed τ event set and by the directed search for such decays be given with smaller than 1% (95% c.l.). (orig./HSI).

37778 (RCNP-P–107, pp. 26-35) **PP scattering with an internal target.** Kobayashi, Y. (Tohoku Univ., Sendai (Japan). Dept. of Physics); Kobayashi, K.; Nakagawa, T. Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

This is a brief report on the measurement of the continuous energy dependence of the analyzing power in proton-proton scattering during polarized beam acceleration from 500 to 3500 MeV. The measurement was done in the KEK-PS tunnel using an internal polyethylene thread target. The energy bin size ranges from 4 to 17 MeV. Statistical uncertainty of the analyzing power is typically 0.5% per energy bin. Small narrow structures have been observed at the invariant mass of 2158 MeV, 2195 MeV and 2243 MeV. (author).

37779 (TRI-PP–90-20) **Recent results from rare kaon decay experiments.** Bryman, D. TRIUMF, Vancouver, BC (Canada). Apr 1990. 5p. (CONF-9002118–2: 1990 Lake Louise winter institute: the standards model and beyond, Lake Louise (Canada), 18-24 Feb 1990). Order Number DE90013106. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

An updated review of recent experimental results involving rare kaon decays is presented. The current round of experiments has already resulted in increased detection sensitivity ranging from one to two orders of magnitude. Further advances are anticipated. 44 refs., 10 figs., 2 tabs.

37780 Null result for the weight change of a spinning gyroscope. Nitschke, J.M. (Nuclear Science Division, Lawrence Berkeley Laboratory, 1 Cyclotron Road, Berkeley, California 94720 (USA)); Wilmarth, P.A. *Physical Review Letters (USA),* 64(18): 2115-2116 (30 Apr 1990). DOE Contract AC03-76SF00098.

A null result was obtained for the weight change of a right-spinning gyroscope, contradicting the results recently reported by Hayasaka and Takeuchi. No weight change could be observed under a variety of spin directions for rotational frequencies between 0 and 2.2×10^4 rpm. Our limit of -0.025 ± 0.07 mg is more than 2 orders of magnitude smaller than the effect reported by Hayasaka and Takeuchi.

37781 Exclusive and inclusive decays of *B* mesons into D_s mesons. Bortoletto, D.; Goldberg, M.; Horwitz, N.; Jain, V.; Mestayer, M.D.; Moneti, G.C.; Sharma, V.; Shipsey, I.P.J.; Skwarnicki, T.; Thulasidas, M. *Physical Review Letters (USA),* 64(18): 2117-2120 (30 Apr 1990). DOE Contract FG05-86ER40272.

We have studied the production of D_s mesons in the decays of *B* mesons at the $\Upsilon(4S)$ resonance. We report on the first observation of exclusive *B*-meson decays $B\rightarrow D_s{}^-D^{*+}$, $B\rightarrow D_s{}^-D^+$, and $B\rightarrow D_s{}^-D^0$. We also present a new measurement of the branching ratio and the momentum spectrum for the inclusive decay $B\rightarrow D_sX$.

37782 Nuclear dependence of dimuon production at 800 GeV. Alde, D.M.; Baer, H.W.; Carey, T.A.; Garvey, G.T.; Klein, A.; Lee, C.; Leitch, M.J.; Lillberg, J.W.; McGaughey, P.L.; Mishra, C.S. *Physical Review Letters (USA),* 64(21): 2479-2482 (21 May 1990).

A precise measurement of the atomic-mass dependence of dimuon production induced by 800-GeV protons is reported. Over 450 000 muon pairs with dimuon mass $M\geq4$ GeV were recorded from targets of ^{2}H, C, Ca, Fe, and W. The ratio of dimuon yield per nucleon for nuclei versus ^{2}H, $R=Y_A/Y_{2H}$, is sensitive to modifications of the antiquark sea in nuclei. No nuclear dependence of this ratio is observed over the range of target-quark momentum fraction $0.1<x_t<0.3$. For $x_t<0.1$ the ratio is slightly less than unity for the heavy nuclei. These results are compared with predictions of models of the European Muon Collaboration effect.

37783 Resonant substructure in $K^-\pi^+\pi^+\pi^-$ decays of D^0 mesons. Adler, J.; Bai, Z.; Blaylock, G.T.; Bolton, T.; Brient, J.; Browder, T.E.; Brown, J.S.; Bunnell, K.O.; Burchell, M.; Burnett, T.H. (Mark III Collaboration). *Physical Review Letters (USA),* 64(22): 2615-2618 (28 May 1990). DOE Contract AA03-76SF00034.

We determine the resonant substructure of $D^0\rightarrow K^-\pi^+\pi^+\pi^-$ decays using a five-dimensional maximum-likelihood technique to extract the relative fractions and phases of the amplitudes contributing to this final state. We find that two-body decay modes account for at least 76% of all decays. We obtain branching ratios for several decay modes including $B(D^0\rightarrow K^-a_1{}^+)=(9.0\pm0.9\pm1.7)\%$, $B(D^0\rightarrow\bar{K}^{*0}\rho^0)=(1.9\pm0.3\pm0.7)\%$, and $B(D^0\rightarrow K_1(1270)^-\pi^+)=(1.8\pm0.5\pm0.8)\%$. For the decay mode $D^0\rightarrow\bar{K}^{*0}\rho^0$, the $\bar{K}^{*0}$ and ρ^0 are found to be polarized with their spins oriented in the direction of their motion as seen from the D^0 frame.

37784 Polarized-target asymmetry in pion-proton bremsstrahlung at 298 MeV. Bosshard, A.; Amsler, C.; Bistirlich, J.A.; van den Brandt, B.; Crowe, K.M.; Doebeli, M.; Doser, M.; Haddock, R.P.; Konter, J.A.; Ljungfelt, S. *Physical Review Letters (USA),* 64(22): 2619-2622 (28 May 1990). DOE Contract AC03-76SF00098.

First data are presented for the polarized-target asymmetry in the reaction $\pi^+p\rightarrow\pi^+p\gamma$ at an incident pion energy of 298 MeV. The geometry was chosen to maximize the sensitivity to the radiation of the magnetic dipole moment μ_Δ of the Δ^{++}(1232 MeV). A fit of the asymmetry in the cross section $d^5\sigma/d\Omega_\pi\ d\Omega_\gamma\ dk$ as a function of the photon energy k to predictions from a recent isobar-model calculation with μ_Δ as the only free parameter yields $\mu_\Delta=1.64(\pm0.19\exp\Delta,\pm0.14\ \text{theor})\mu_p$. Though this value agrees with bag-model corrections to the SU(6) prediction $\mu_\Delta=2\mu_p$, further clarifications on the model dependence of the result are needed, in particular since the isobar model fails to describe both the cross section and the asymmetry at the highest photon energies.

37785 Improved experimental limit on $K_L\rightarrow\pi^0e^+e^-$. Ohl, K.E. (Department of Physics, Yale University, New Haven, Connecticut 06511 (US)); Adair, R.K.; Greenlee, H.B.; Kasha, H.; Mannelli, E.B.; Schmidt, M.P.; Vagins, M.R.; Jastrzembski, E.; Larsen, R.C.; Leipuner, L.B. *Physical Review Letters (USA),* 64(23): 2755-2758 (4 Jun 1990). DOE Contract AC02-76ER03075 ;AC02-76CH00016.

We report on results of a dedicated search for the *CP*-violating decay $K_L\rightarrow\pi^0e^+e^-$. We have found no evidence for this decay mode and obtain a 90%-confidence upper limit of 5.5×10^{-9} for its branching ratio.

37786 Analyzing power measurement for forward angle *n-p* scattering at 790 MeV. Glass, G. (Texas A&M University, College Station, Texas 77843 (USA)); Bhatia, T.S.; Hiebert, J.C.; Kenefick, R.A.; Nath, S.; Northcliffe, L.C.; Johnson, K.F.; Spinka, H.; Stanek, R.; Rawool, M.W. *Physical Review, C (Nuclear Physics) (USA),* 41(6): 2732-2736 (Jun 1990). DOE Contract AS05-76ER04449.

A measurement of the analyzing power for *n-p* scattering has been made at center-of-mass angles, 8.8°, 15.0°, and 20.7° with a

nearly monoenergetic polarized neutron beam peaked at 790 MeV. These angles represent an acceptance from 5° to 30° in the center of mass, and therefore extend to the smallest angles yet reached for measurement of this observable. The data are compared with the predictions of several phase shift analyses, and with the results from previous measurements that extend to larger angles for both free and quasifree *n-p* scattering.

6452 Particle Interactions and Properties - Theoretical

Refer also to citation(s) 37753, 37813, 37895

37787 (ISN–89-40) **Neutron-Antineutron oscillations in nuclei.** Richard, J.M. (Grenoble-1 Univ., 38 (FR). Inst. des Sciences Nucleaires); Dover, C.B.; Gal, A. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1989. 6p. (CONF-8903138–: ILL workshop on fundamental physics with slow neutrons, Grenoble (France), 8-11 Mar 1989). Order Number DE90500783. Available from NTIS (US Sales Only), PC A02/MF A01.

We briefly review the state of the art for extracting the period of neutron-antineutron oscillations from the lifetime of nuclei. The most recent data on nuclear stability provide a limit of 10^8 s for the oscillation period.

37788 (NBI-HE–90-03) **Baryons and ladders.** Ball, R.D. Niels Bohr Inst., Copenhagen (Denmark). Jan 1990. 11p. Order Number DE90630816. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

By formal manipulation of the QCD functional integral we arrive at a relativistic low energy effective theory of non-local color singlet mesons and baryons, which at tree level sums up ladders of effective glue exchange between constituent quarks. (orig.).

37789 (RAL–90-007) **Parton distributions extracted from data on deep-inelastic lepton scattering, prompt photon production and the Drell-Yan process.** Harriman, P.N. (Durham Univ. (UK). Dept. of Physics); Martin, A.D.; Stirling, W.J.; Roberts, R.G. Rutherford Appleton Lab., Chilton (UK). Jan 1990. 37p. (DTP–90-04). Order Number DE90630817. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We present a next-to-leading-order QCD structure function analysis of deep-inelastic muon and neutrino scattering data. In particular, we incorporate new $F_2^{\mu n}/F_2^{\mu p}$ data and take account of a recent re-analysis of SLAC data. The fit is performed simultaneously with next-to-leading-order fits to recent prompt photon and Drell-Yan data. As a result we are able to place tighter constraints on the quark and gluon distributions. Two definitive sets of parton distributions are presented according to which set of muon data is included in the global fit. Comparisons with distributions obtained in earlier analyses are made and the consistency of data sets is investigated. (author).

37790 (RAL–90-010) **QCD mixing effects in a gauge invariant quark model for photo- and electroproduction of baryon resonances.** Zhenping Li (Tennessee Univ., Knoxville, TN (USA). Dept. of Physics); Close, F.E. Rutherford Appleton Lab., Chilton (UK). Mar 1990. 20p. Contract DE-AC05-840R21400. (UTK–90-3). Order Number DE90630818. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The photo and electroproduction of baryon resonances has been calculated using the Constituent Quark Model with chromodynamics consistent with $O(v^2/c^2)$ for the quarks. We find that the successes of the nonrelativistic quark model are preserved, some problems are removed and that QCD mixing effects may become important with increasing q^2 in electroproduction. For the first time both spectroscopy and transitions receive a unified treatment with a single set of parameters. (author).

37791 (RCNP-P–106, pp. 99-104) **A study on low-energy proton-antiproton pair annihilation by means of planar quark diagram picture.** Maruyama, Masahiro (Tohoku Univ., Sendai (Japan). Faculty of Science). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8905289–: Workshop on few-body systems, Ibaraki (Japan), 22-24 May 1989). In *Proceedings of the workshop on few-body systems.* Order Number DE90760000. Available from NTIS (US Sales Only), PC A08/MF A01.

The process of annihilation of a proton-antiproton pair at rest or in flight into the final meson state is analyzed by means of a quark planar diagram model. The transition to two (three) mesons in the final state is explained as the process of annihilation of two quark-antiquark pairs from the initial proton-antiproton state followed by the production of one (two) quark-antiquark pair(s). A constituent quark model is applied to the quark wave function. The annihilated and produced quark pairs are assumed to have the quantum number in vacuum. The meson branching ratio in the final state of the process of proton-antiproton pair annihilation at rest and in flight is calculated and compared with observations. It is revealed that the model can explain most of the experimental data. Investigation is also made on the relativistic effects in the proton-antiproton annihilation into two mesons. It is shown that the relativistic effects are not so significant that non-relativistic calculations can provide good approximation as long as the meson branching ratio is concerned. (N.K.).

37792 (RCNP-P–106, pp. 90-98) **Some issues in elementary particle physics involving low-energy neutrons and antiprotons focusing on measurement of violated symmetry.** Masaike, Akira (Kyoto Univ. (Japan). Faculty of Science). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8905289–: Workshop on few-body systems, Ibaraki (Japan), 22-24 May 1989). In *Proceedings of the workshop on few-body systems.* Order Number DE90760000. Available from NTIS (US Sales Only), PC A08/MF A01.

The report addresses the observation of violation of the P, T, CP and CPT symmetries by means of ultra-low energy neutrons and antiprotons, focusing on the measurement of the electric dipole moment of neutrons, observations of P and T nonconservation in resonance absorption reaction, study on CP nonconservation in antiproton-proton annihilation reaction, and feasibility of measuring the gravity imposed on antiprotons. P and T nonconservation occurs if an elementary particle has an electric dipole moment. The electric dipole moment of neutrons can be measured very accurately, providing a useful means of determining the T nonconservation. Ultra-cold neutrons recently have been used for this purpose. P and T nonconservation can be examined also by means of nuclear reactions. In a neutron reaction, T nonconservation can be studied by measuring the degree of asymmetry in the scattering cross section while keeping the direction of the neutron spin perpendicular to that of the target nuclear spin in the plane perpendicular to the beam. (N.K.).

37793 (RCNP-P–106, pp. 113-121) **Is there any quark effect seen in triton?.** Sasakawa, T. (Tohoku Univ., Sendai (Japan). Dept. of Physics). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (CONF-8905289–: Workshop on few-body systems, Ibaraki (Japan), 22-24 May 1989). In *Proceedings of the workshop on few-body systems.* Order Number DE90760000. Available from NTIS (US Sales Only), PC A08/MF A01.

The report presents calculations of various triton observables and discusses to what extent a potential model approach can be successful in describing the triton properties. A potential model approach is proposed first together with major results obtained. Then discussion is made of these results focusing on phenomena that are likely to involve quark effects. Some other phenomena which might reveal the quark effects are also outlined and finally, possible future trends in this research area are discussed. Although some researchers have attempted to explain the CSB in terms of the u-d quark mass difference, detailed analysis of ^{3}H-^{3}He mass difference made here indicates that it would be impossible to find positive evidence of the necessity for introducing quarks to explain this phenomenon. In the quasielastic electron scattering, an overall agreement between experimental and theoretical results is expected to be achieved by means of a Faddeev bound state wave function for realistic two- and three-nucleon forces in combination with a Faddeev continuum wave function which takes into account the distortion caused by nuclear interactions. Two quark model approaches are currently available to calculate the triton binding

energy. One is the quark cluster model approach and another one is the P matrix approach. (N.K.).

37794 (TRI-PP-90-13) **Leptonic CP violation in leptoquark models.** Geng, C.Q. TRIUMF, Vancouver, BC (Canada). Mar 1990. 12p. Order Number DE90013103. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

We study the leptonic CP violation effects in leptoquark models. We show that in general the leptoquark contribution to the longitudinal muon polarization effect in $\eta \rightarrow \mu^+\mu^-$ decay is very small and in a model which has no couplings induced by the leptoquark between different generations, both the electric dipole moment of electron or muon and longitudinal polarization of electron in π^0, $\eta \rightarrow e^+e^-$ decays can be large. 14 refs.

37795 The renormalization group improved YFS [Yennie-Frautschi-Suura] method in QED. Jadach, S. (CERN, Geneva 23, Switzerland (CH)); Ward, B.F.L. *AIP Conference Proceedings (American Institute of Physics) (USA),* 201(1): 201-215 (5 Mar 1990). DOE Contract AS05-76ER03956. (CONF-8905213--: QED structure functions workshop, Ann Arbor, MI (USA), 22-25 May 1989).

We review the recently introduced Monte Carlo renormalization group improved Yennie-Frautschi-Suura method as it applies to higher order QED radiative corrections. Explicit Monte Carlo realizations are presented. Sample Monte Carlo data are illustrated which are of immediate interest to SLC and LEP scenarios. In this way the effects of multiple photon final states on high precision Z^0 physics are assessed.

37796 Noodles and stars allow a precise and efficient calculation of the Z-line shape and the polarization asymmetry. Jung-Choon Im, C. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309 (USA)). *AIP Conference Proceedings (American Institute of Physics) (USA),* 201(1): 259-286 (5 Mar 1990). (CONF-8905213--: QED structure functions workshop, Ann Arbor, MI (USA), 22-25 May 1989).

We give a pedagogical introduction to the star functions and the Noodle method. The Z-line shape and the polarization asymmetry at SLC/LEP can be evaluated elegantly and efficiently using the star functions and the Noodle method.

37797 Radiative corrections at SLC and LEP. Rankin, P. (Department of Physics, University of Colorado, Boulder, Colorado, 80309-309 (USA)). *AIP Conference Proceedings (American Institute of Physics) (USA),* 201(1): 287-310 (5 Mar 1990). DOE Contract AC02-86ER40253. (CONF-8905213--: QED structure functions workshop, Ann Arbor, MI (USA), 22-25 May 1989).

This paper discusses the extraction of electroweak parameters from measurements of the Z^0 line shape and asymmetries at the Z^0 pole. The likely limits to the experimentally attainable accuracy are compared to the limitation due to the theoretical implementation of radiative corrections.

37798 An inclusive and exclusive algorithm for QED evolution. Bonvicini, G. (University of Michigan, Ann Arbor, MI 48109 (USA)); Trentadue, L. *AIP Conference Proceedings (American Institute of Physics) (USA),* 201(1): 216-242 (5 Mar 1990). DOE Contract AC02-76ER01112. (CONF-8905213--: QED structure functions workshop, Ann Arbor, MI (USA), 22-25 May 1989).

A novel algorithm to calculate radiative corrections to e^+e^- annihilation which is both inclusive and exclusive is proposed. The method uses the structure functions formalism and is based on the factorization of mass singularities in the QED perturbation expansion. The general approach is presented together with its ability to reproduce the infrared and collinear singularity structure of QED as well as the all-order multiple photon radiation. Some numerical results are given.

37799 Heavy flavor resonances and QED radiative corrections. Alexander, J. (Lawrence Berkeley Laboratory, University of California, Berkeley CA 94720 (USA)); Bonvicini, G.; Drell, P.; Frey, R.; Luth, V. *AIP Conference Proceedings (American Institute of Physics) (USA),* 201(1): 326-346 (5 Mar 1990). DOE Contract AC03-76SF00515 ;AC03-76SF00098 ;AC02-76ER01112. (CONF-8905213--: QED structure functions workshop, Ann Arbor, MI (USA), 22-25 May 1989).

An application of high precision QED against experimental data is presented. When the corrections to ψ and Υ families are improved according to the method described below, the masses and widths of the resonances below open flavor threshold change by up to three standard deviations from presently accepted experimental values.

37800 Neutrino counting at e^+e^- colliders. Wilson, R.J. (Boston University, Boston, Massachusetts, 02215 (USA)). *AIP Conference Proceedings (American Institute of Physics) (USA),* 201(1): 360-394 (5 Mar 1990). DOE Contract AC02-86ER40284. (CONF-8905213--: QED structure functions workshop, Ann Arbor, MI (USA), 22-25 May 1989).

We discuss the experimental techniques required to make a measurement of the number of neutrinos at e^+e- colliders. A summary of studies performed by the ASP and SLD collaborations at SLAC, is presented.

37801 Study of the all neutral final state of $f_2(1270)$ produced in two-photon collisions as a background to radiative neutrino counting on the Z^0 resonance. Daoudi, M. (Physics Department, University of California, Riverside, California (USA)); Layter, J.G.; Riles, K.; Shen, B.C. *AIP Conference Proceedings (American Institute of Physics) (USA),* 201(1): 428-440 (5 Mar 1990). DOE Contract AM03-76SF00010. (CONF-8905213--: QED structure functions workshop, Ann Arbor, MI (USA), 22-25 May 1989).

Upcoming experiments at LEP will measure the number of neutrino generations from the cross section for single-photon productions in e^+e^- annihilation on or above the Z^0 resonance. We consider one potential background to this process, two-photon production of f_2, with subsequent decay into four photons. Monte Carlo studies of this reaction are presented and the results discussed. From analysis of a sample corresponding to 10 pb^{-1} of integrated luminosity, we conclude this reaction constitutes a small, and for certain event selection criteria, a negligible background.

37802 One-jet inclusive cross section at order α_s^3: Quarks and gluons. Ellis, S.D. (Department of Physics, FM-15, University of Washington, Seattle, Washington 98195 (USA)); Kunszt, Z.; Soper, D.E. *Physical Review Letters (USA),* 64(18): 2121-2124 (30 Apr 1990). DOE Contract AS06-88ER40423 ;FG06-85ER40224.

The next-to-leading order inclusive jet cross section is calculated including both quarks and gluons. The general structure of the dependence of the cross section on the explicit jet definition and on the choice of the renormalization scale μ^2 is found to be very similar to the case of gluons only, calculated earlier. The resulting cross section is shown to involve a much reduced theoretical uncertainty compared to the lowest-order result. First comparisons with experimental data are also exhibited.

37803 Tensor coupling of the ρ meson in a chiral confining model. Ren, C. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742 (USA)); Banerjee, M.K. *Physical Review, C (Nuclear Physics) (USA),* 41(5): 2370-2379 (May 1990). DOE Contract FG05-87ER40322.

Both the field current identity and universal coupling imply that the isovector part of the anomalous magnetic moment of the nucleon, κ_V, is equal to the tensor coupling of the ρ meson, κ_ρ. However, the empirical value of κ_ρ/κ_V extracted through dispersion relation is 1.78. In this paper we show that a color dielectric model can explain in a natural way why the ratio $\kappa_\rho/\kappa_V>1$. We study a chirally invariant color dielectric model. We point out that a fractional power of the color dielectric function should be present in the quark-meson interaction term. The quark part of the ρ meson current, modified by this factor, is *structurally* different from the isovector part of the electromagnetic current. Both the magnetic-moment-like quantity, $\mu_{(\rho)}$, and the ρ-nucleon coupling constant, $g_{\rho NN}$, are modified making $\kappa_\rho=(\mu_{(\rho)p}-\mu_{(\rho)n})(2M/g_{\rho NN})-1$ different from κ_V and, indeed, larger than κ_V. The numerical value of the ratio κ_ρ/κ_V is found to be 1.35, quite independent of the details of the model. It appears that some additional mechanism is needed to fit the value 1.78.

37804 Late-time dissipation of primordial baryon-number fluctuations and nucleosynthesis. Alcock, C.R. (Institute of Geophysics and Planetary Physics, Lawrence Livermore National Laboratory, University of California, Livermore, California 94550 (US)— Department of Physics and Center for Astrophysics and Space Science, University of California a *Physical Review Letters (USA)*, 64(22): 2607-2610 (28 May 1990). DOE Contract W-7405-ENG-48.

Primordial baryon-number fluctuations can be damped at temperatures ≈20 keV when the photon mean free path becomes larger than the high-density-region length scale. This dissipation process may result in mixing of the high- and low-density material on a time scale comparable to or shorter than that of the universal expansion. The nucleosynthesis yields in inhomogeneous cosmologies can be altered by this process for any Ω_b. ^{7}Li can be reduced to an abundance consistent with observations of Population II halo stars and the abundances of ^{9}Be and ^{10}B can be reduced by several orders of magnitude.

6453 Particle Invariance Principles and Symmetries

Refer also to citation(s) 37819, 37821, 37917, 37996

37805 (KEK–89-17, pp. 22-41) **Physics of the B system.** Sanda, A.I. (Rockefeller Univ., New York, NY (USA)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Nov 1989. (CONF-8910393–: Workshop for asymmetric B-factory at KEK, Tsukuba (Japan), 2-4 Oct 1989). In *Proceedings of the workshop on asymmetric B factory at KEK*. Order Number DE90777869. Available from NTIS (US Sales Only), PC A12/MF A01.

We discuss a strategy for studying CP violation in the B system using the framework of the unitarity triangle. A special attention is placed on obtaining the parameters of the triangle with minimal of strong interaction ambiguities. Some aspects of rare B decays are also mentioned. (author).

37806 (KEK–89-22) **Proceedings of the workshop 'topology, field theory and superstrings'.** Kobayashi, Makoto; Nojiri, Shin-ichi (eds.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jan 1990. 396p. (CONF-8911199–: Workshop on topology, field theory and superstrings, Tsukuba (Japan), 6-10 Nov 1989). Order Number DE90798858. Available from NTIS (US Sales Only), PC A17/MF A01.

This issue is the collection of the papers presented at the title meeting. The 27 of the presented papers are indexed individually. (J.P.N.).

37807 (RCNP-P–107, pp. 80-89) **Origin of CP violation.** Yamaguchi, Yoshio (Tokai Univ., Hiratsuka, Kanagawa (Japan). Faculty of Science). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'*. Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

The 2π decays of the K_L-meson, a unique and clear-cut evidence for CP violation, demonstrate an existence of C conserving but P violating and CP violating interaction $H_X{}^C$. This new interaction $H_X{}^C$ is flavor conserving and its effective strength is $\approx 10^{-3}$ of that of strong interaction. Implication of $H_X{}^C$ in particle and nuclear physics and nature of the spinless force carrier of $H_X{}^C$ are briefly described. (author).

37808 The linearized gauge field propagator in an inhomogeneous medium. Tang, P. (Department of Physics, FM-15, University of Washington, Seattle, Washington 98195 (US)); Wilets, L. *Journal of Mathematical Physics (New York) (USA)*, 31(7): 1661-1669 (Jul 1990).

In an inhomogeneous medium with $\mu=\kappa^{-1}$, the linearized gauge field propagator is presented in terms of spherical harmonics for the Coulomb gauge. Explicit expressions for the propagator are given in the case of the MIT bag for both the Coulomb and Lorentz gauges. Gauge invariance is shown explicitly for the one gluon interaction in the MIT bag. This work supplements and corrects the earlier work by Bickeboeller, Goldflam, and Wilets [J. Math. Phys. **26**, 1810 (1985)].

6454 Field Theory

Refer also to citation(s) 37753, 37754, 37795, 37992, 37996, 38054

37809 (NBI-HE–89-58) **The bosonic string represented as ϕ^3 graphs: New Monte Carlo simulations.** Ambjoern, J. (Niels Bohr Inst., Copenhagen (Denmark)); Boulatov, D.; Kazakov, V.A. Niels Bohr Inst., Copenhagen (Denmark). Feb 1990. 16p. Order Number DE90630621. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We discuss a new method for measuring the critical exponent γ for the partition function of the Bosonic string. The statistics seems very good and the fit to γ consists with the assumed asymptotic form for the partition function for dimensions d=1-6. The results are in agreement with analytical results when the target space dimension is d=0, but disagree when d=1. We conjecture that this is due to the appearance of logarithmic corrections to the asymptotic form of the partition function. These corrections might persist for d>1 and might render a determination of γ quite difficult. (orig.).

37810 (NBI-HE–90-11) **The β-function in 4-dimensional topological Yang-Mills theory.** Madsen, J.O. Niels Bohr Inst., Copenhagen (Denmark). Mar 1990. 6p. Order Number DE90630622. Available from NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

We calculate the β-function in Witten's 4-dimensional topological Yang-Mills theory, using the heat kernel method. (orig.).

37811 (NBI-HE–90-12) **Duality and modular invariance in rational conformal field theories.** Li Miao. Niels Bohr Inst., Copenhagen (Denmark). Mar 1990. 48p. Order Number DE90630623. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

We investigate the polynomial equations which should be satisfied by the duality data for a rational conformal field theory. We show that by these duality data we can construct some vector spaces which are isomorphic to the spaces of conformal blocks. One can construct explicitly the inner product for the former if one deals with a unitary theory. These vector spaces endowed with an inner product are the algebraic reminiscences of the Hilbert spaces in a Chern-Simons theory. As by-products, we show that the polynomial equations involving the modular transformations for the one-point blocks on the torus are not independent. And along the way, we discuss the reconstruction of the quantum group in a rational conformal theory. Finally, we discuss the solution of structure constants for a physical theory. Making some assumption, we obtain a neat solution. And this solution in turn implies that the quantum groups of the left sector and of the right sector must be the same, although the chiral algebras need not to be the same. Some examples are given. (orig.).

37812 (SLAC-PUB–5185) **A finite, rational model for the EPR-Bohm experiment.** Noyes, H.P. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jan 1990. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-900862–1: Symposium on the foundations of modern physics, Joensuu (Finland), 13-17 Aug 1990). Order Number DE90006456. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

We construct 3 + 1 space-time and particles from bit-strings of finite length. At an early stage in the construction, we find that we can identify single particle Dirac wave functions. Considering a space-like trajectory for a single particle we find the usual spin correlations which violate Bell's inequalities. The only "non-local" parameter is our discrete version of the global time ordering of special relativity. 23 refs.

37813 The structure of gluon radiation in QCD. Parke, S. (Fermi National Accelerator Laboratory P.O. Box 500, Batavia, IL 60510 (USA)); Mangano, M. *AIP Conference Proceedings (American Institute of Physics) (USA)*, 201(1): 91-104 (5 Mar 1990). (CONF-8905213–: QED structure functions workshop, Ann Arbor, MI (USA), 22-25 May 1989).

For massless QCD the hard scattering amplitudes are naturally written in terms of the dual color expansion. Here I present this expansion for purely gluonic processes and processes involving quark-antiquark pairs and gluons. The properties of the subamplitudes as well as explicit algebraic expressions are given for a number of these processess. Finally, I demonstrate how to recover massless QED amplitudes from the dual expansion of massless QCD.

37814 The Dirac equation in a non-Riemannian manifold: II. An analysis using an internal local *n*-dimensional space of the Yang–Mills type. Marques-Bonham, S. (NASA/Fermilab Astrophysics Center, Fermi National Accelerator Laboratory, M.S. 209, P.O. Box 500, Batavia, Illinois 60510 (USA)). *Journal of Mathematical Physics (New York) (USA),* 31(6): 1478-1482 (Jun 1990).

The geometrical properties of a flat tangent space-time local to the generalized manifold of the Einstein–Schroedinger nonsymmetric theory, with an internal *n*-dimensional space with the SU(*n*) symmetry group, is developed here. As an application of the theory, a generalized Dirac equation, where the electromagnetic and the Yang–Mills fields are included in a more complex field equation, is then obtained. When the two-dimensional case is considered, the theory can be immediately interpreted through the algebra of quaternions, which, through the Hurwitz theorem, presupposes a generalization of the theory using the algebra of octonions.

37815 Towards a bosonization of quantum electrodynamics. Hong, D.K. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627 (US)); Rajeev, S.G. *Physical Review Letters (USA),* 64(21): 2475-2478 (21 May 1990). DOE Contract AC02-76ER13065.

We study the strong phase of QED with more than one flavor $N_f > 1$, and spontaneously broken chiral symmetry, using an effective Lagrangian. The effective Lagrangian contains a massless e^+e- bound state (the "electropion") and the photon. This theory is shown to predict the existence of a fermionic soliton. We argue that this soliton must be the electron. The mass of the electron is calculated to be in the range $2.23F < m < 3.33F$, where e is the electron charge and F is the electropion decay constant. Since the mass is finite, we conclude that strongly coupled QED does not show confinement.

37816 Supersymmetry breaking with vanishing cosmological constant in string theory. Burgess, C.P. (Department of Physics, McGill University, 3600 University Street, Montreal, Quebec, (Canada) H3A2T8); Quevedo, F. *Physical Review Letters (USA),* 64(22): 2611-2614 (28 May 1990).

We show that for the effective four-dimensional $N=1$ supergravity governing string theory around a large class of vacua the scalar potential is the sum of non-negative terms even in the presence of supersymmetry breaking. It is therefore naturally minimized with vanishing cosmological constant. Our result relies only on generic features of these vacua that have been proven for string tree level and at all orders in σ-model perturbation theory, but appear to apply more generally, for example, holding exactly in the σ-model couplings for (0,2) Z_N orbifold models of rank 16.

37817 Scalar-tensor gravitational effects on vacuum decay. Accetta, F.S. (Center for Theoretical Physics, Department of Physics, Yale University, New Haven, Connecticut 06511 (USA)); Romanelli, P. *Physical Review, D (Particles Fields) (USA),* 41(10): 3024-3037 (15 May 1990). DOE Contract AC02-76ER03075.

Motivated by a recently proposed "extended" inflation scenario, we apply the formalism of Coleman and De Luccia to the false-vacuum decay of a scalar field coupled to a scalar-tensor theory of gravity. In particular, we discuss a model for false-vacuum decay of a scalar field σ minimally coupled in a Brans-Dicke-like theory of gravity. In such theories, the effective gravitational constant is a function of a scalar field ϕ. In general, ϕ will have nontrivial dynamics in the false vacuum, and as ϕ varies the decay rate of the σ false vacuum need not be constant. We present both an explicit "thin-wall" calculation of the decay rate, and a more general numerical "thick-wall" calculation, comparing them to the standard results for Einstein gravity. We consider some questions of principle concerning boundary conditions for the ϕ field. We discuss the consequences of these results for extended models of inflation.

37818 Stability of random surfaces. Krzywicki, A. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973 (US)). *Physical Review, D (Particles Fields) (USA),* 41(10): 3086-3089 (15 May 1990). DOE Contract AC02-76CH00016.

The interaction of two-dimensional quantum gravity with a set of conformal matter fields is considered. Following an earlier suggestion by Cates, we calculate the free energy of a "spiky" Liouville field configuration at a fixed value of the proper-time cutoff and including lowest-order quantum corrections. This free energy becomes arbitrarily large negative as soon as the central charge of the matter fields is larger than unity.

37819 Deformations of conformal field theories and symmetries of the string. Evans, M. (The Rockefeller University, 1230 York Avenue, New York, New York 10021-6399 (USA)); Ovrut, B.A. *Physical Review, D (Particles Fields) (USA),* 41(10): 3149-3158 (15 May 1990). DOE Contract AC02-76ER03071.

Gauge symmetries in closed-string theory, and their relationship to world-sheet conformal invariance, are investigated. By studying the deformations of conformal field theories in the operator formalism, it is proved that to every primary field of dimension one there corresponds a gauge transformation. An infinite class of such gauge transformations is constructed, most of which relate string states of differing mass. It is argued that these symmetries are spontaneously broken by the space-time metric, but that this breaking becomes unimportant for high-energy scattering, thus shedding light on the results of Gross and Mende.

37820 Singularity of Green's function and effective action in massive Yang-Mills theories. Coriano, C. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794 (US)); Yamagishi, H. *Physical Review, D (Particles Fields) (USA),* 41(10): 3226-3232 (15 May 1990). DOE Contract FG02-88ER40388.

The singularities of the one-loop Green's function and the effective action in massive Yang-Mills theory are investigated, in terms of the original (Proca) variables. Although the result is nonrenormalizable, a high degree of predictive power can be maintained.

37821 Chiral logarithms in quenched m_π and f_π. Sharpe, S.R. (Department of Physics, FM-15, University of Washington, Seattle, Washington 98195 (US)). *Physical Review, D (Particles Fields) (USA),* 41(10): 3233-3240 (15 May 1990). DOE Contract AS06-88ER40423.

A diagrammatic analysis predicts that, in the quenched approximation, there should be no chiral logarithms, at leading order, in m_π or f_π, for gauge groups SU($N \geq 3$). Morel has done an explicit calculation in the strong-gauge-coupling, large-dimension limit, and finds that there are such logarithms. I point out that Morel's calculation is of a quantity different from the quenched pion propagator. I show that if one calculates the correct quantity then there are no chiral logarithms. For SU(2), however, the diagrammatic analysis predicts that there are chiral logarithms in quenched m_π and f_π.

37822 Hot δ expansion. Bender, C.M. (Department of Physics, Washington University, St. Louis, Missouri 63130 (USA)); Rebhan, A. *Physical Review, D (Particles Fields) (USA),* 41(10): 3269-3272 (15 May 1990).

The δ expansion, a novel perturbative scheme for quantum field theories, is investigated in the case of finite temperatures. For the exactly solvable example of the large-N limit of massless scalar four-dimensional ϕ^4 theory, the first two orders of the δ expansion are compared with ordinary perturbation theory which at finite temperature is infrared singular beyond one-loop order. The δ expansion gives results which are nonperturbative with respect to the coupling constant and which compare favorably with the exact solution. Most importantly, the δ series naturally solves the general infrared problem of perturbative high-temperature field theories.

37823 Relativistic energy-momentum relationship for a soliton. Jain, P. (Physics Department, West Virginia University, Morgantown, West Virginia 26506 (US)). *Physical Review, D (Particles Fields) (USA),* 41(10): 3273-3276 (15 May 1990). DOE Contract FG05-86ER40252.

By making a quantum expansion around the boosted soliton, we calculate the one-soliton energy eigenvalue of the renormalized unperturbed Hamiltonian in the (1+1)-dimensional kink field theory and demonstrate its relativistic dependence on the momentum.

65 PHYSICS II

6510 Nuclear Physics

Refer also to citation(s) 37426, 37515, 37752

37824 (BNL–44710) **Charged particle distributions in heavy ion collisions at 14.6 GeV A/c.** Videbaek, F. Brookhaven E-802 Collaboration. Brookhaven National Lab., Upton, NY (USA). [1990]. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-900331–10: Workshop on heavy ion physics at the alternating gradient synchrotron, Upton, NY (USA), 3-7 Mar 1990). Order Number DE90012871. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Data on charged particle distributions from reactions with Si and O projectiles on various target are presented. Systematic features of the pseudorapidity distributions are discussed. 3 refs., 3 figs.

37825 (BNL–44713) **A search for long-lived low mass states coupling to e^+e^-.** Henderson, S.D. (Yale Univ., New Haven, CT (USA). Wright Nuclear Structure Lab.); Greenberg, J.S.; McDonough, J.; Phlips, B.F.; Kumar, P.A.; Huomo, H.; Lynn, K.G.; McCorkle, S.; Vehanen, A.; Weber, M. Brookhaven National Lab., Upton, NY (USA). [1990]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016 ;AC02-76ER03074. (CONF-900601–1: 12. international conference on particles and nuclei, Cambridge, MA (USA), 24-29 Jun 1990). Order Number DE90012870. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Since the observation by the EPOS group at GS in 1985 of correlated electron-positron pair emission in superheavy ion-atom collision systems there have been many attempts to explain the phenomenon. The EPOS coincidence data show a series of narrow sum-energy lines in the laboratory kinetic energy range 610–820 keV. Recently, similar observations were reported by another group. For lack of conventional explanations for the narrow sum peaks, the production of a previously unobserved neutral system in the heavy ion collision which subsequently decays to e^+e^- was considered as a possibility. If such an object were to exist, then it should be possible to produce it through the s-channel of ordinary electron-positron scattering. We describe the results of a set of experiments to search for such a neutral object directly in e^+e^- collisions.

37826 (CONF-900135–11) **Experimental results from studies on nucleus-nucleus collisions at high energy.** Young, G.R. Oak Ridge National Lab., TN (USA). Jun 1990. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 15. general meeting of the Division of Particles and Fields of the American Physical Society; Houston, TX (USA); 3-6 Jan 1990. Order Number DE90012286. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A short overview is presented of results from the initial accelerator-based studies of collisions of heavy nuclei at high energies. Some comments are made on the global observables studied and their implications for achieving conditions for deconfinement. Finally, information available from certain more specific probes selected for their ability to test whether a deconfined system of quarks and gluons is created in such collisions is presented. 5 refs., 4 figs., 1 tab.

37827 (KEK–89-12, pp. 85-91) **Measurements of magnetic form factor of nucleon and few nucleon system.** Hotta, Akio (Shizuoka Univ. (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Sep 1989. (In Japanese). (CONF-8810498–: Workshop on the experiments by polarized proton and electron beams, Tsukuba (Japan), 27-28 Oct 1988). In *Proceedings of the workshop on the experiments by polarized proton and electron beams.* Order Number DE90777829. Available from NTIS (US Sales Only), PC A11/MF A01.

The deuteron electron scattering experiments are reported in this paper, about two experiments at SLAC (NPAS). (1) The deuteron magnetic form factor $B(Q^2)$ has been measured at high momentum transfer (from Q^2 = 1.21 to 2.77 $(GeV/c)^2$) at SLAC by detecting electrons backscattered at 180deg in coincidence with recoiling deuterons at 0deg. The data for $B(Q^2)$ are found to decrease rapidly from Q^2 = 1.2 to 2 $(GeV/c)^2$, then rise to a secondary maximum around Q^2 = 2.5 $(GeV/c)^2$, in qualitative agreement with impulse approximation calculations. (2) Cross sections for 180deg inelastic electron scattering from the deuteron were measured from threshold to beyond the quasielastic peak from Q^2 = 0.75 to 2.57 $(GeV/c)^2$ at SLAC. The data are in reasonable agreement with nonrelativistic models that include final-state interactions and meson-exchange currents. The neutron magnetic form factor determined from the data are in good agreement with results from previous experiments. (author).

37828 (KEK–89-12, pp. 157-164) **Analyzing power measurements in pp elastic scattering with an internal target.** Kobayashi, Y. (Tohoku Univ., Sendai (Japan). Dept. of Physics); Kobayashi, K.; Nakagawa, T. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Sep 1989. (CONF-8810498–: Workshop on the experiments by polarized proton and electron beams, Tsukuba (Japan), 27-28 Oct 1988). In *Proceedings of the workshop on the experiments by polarized proton and electron beams.* Order Number DE90777829. Available from NTIS (US Sales Only), PC A11/MF A01.

This is a brief report on the measurement of the continuous momentum dependence of the analyzing power in proton-proton elastic scattering during polarized beam acceleration from 1.1 to 4.4 GeV/c. The measurement was done in the KEK-PS tunnel using an internal polyethylene thread target. The momentum bin size ranges from 5 to 18 MeV/c. Statistical uncertainty of the analyzing power is typically 0.5% per momentum bin. Small narrow structures have been observed at the invariant mass of 2.158 GeV, 2.195 GeV and 2.243 GeV. (author).

37829 (NAC-AR–88-01, pp. 70) **Experimental nuclear physics: Differential cross-section for n-p radiative capture at Esub n=61 MeV.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

The angular distribution of photons from the $^1H(n,\gamma)^2H$ reaction at E_n = 61 MeV is being studied using the new collimated neutron beam facility at NAC. There is special interest in measurements at E = 31.5 MeV because a number of experiments have reported data in disagreement with one another and with theoretical predictions. The analyis of the present measurements is now under way and comparisons are being made with calculations based on the Paris potential and other nuclear potentials. 2 figs., 1 ref.

37830 (NAC-AR–88-01, pp. 87-90) **Experimental nuclear physics: Integral excitation functions for proton-induced reactions on Mn and Ni in the energy range 20-200 MeV.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

The measurement and analysis of integral excitation functions for proton-induced reactions on Mn, initiated in the previous annual report year have been continued. The previous measurements were extended from 66 MeV to 200 MeV and the results obtained over the whole energy range from 20 to 200 MeV have been compared with theoretical predictions. As a consequence of the fact that Mn/Ni alloy foils were employed in the foil-stack irradiations, and Ni foils therefore had to be included in the foil stacks in order to enable subtraction of the contribution of the Ni content of the alloy, excitation functions for Ni as target element were automatically also obtained, and formed an inherent part of the present investigation. 2 figs., 16 refs.

37831 (NAC-AR–88-01, pp. 93-95) **Experimental nuclear physics: Continuum decay associated with the scattering of 200 MeV protons from sup 12C.** National Accelerator Centre,

Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

Short note. PROTONS/decay; PROTONS/emission; BINDING ENERGY; COBALT; CROSS SECTIONS; DISTORTED WAVE THEORY; ENERGY SPECTRA; EXCITATION; MEV RANGE 10-100; MEV RANGE 100-1000; NAC CYCLOTRON; NICKEL; PROGRESS REPORT; PROTONS; DECAY; EMISSION; RESEARCH PROGRAMS; SCATTERING

37832 (NAC-AR–88-01, pp. 91-92) **Experimental nuclear physics: Excitation of giant multipole resonances with 120 and 140 MeV alpha particles.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

Short note. ALPHA PARTICLES/resonance scattering; CROSS SECTIONS; ENERGY SPECTRA; EXCITATION; GIANT RESONANCE; GOLD; LI-DRIFTED SI DETECTORS; MEV RANGE 10-100; MEV RANGE 100-1000; MOLYBDENUM; NICKEL; NUCLEAR QUADRUPOLE RESONANCE; PROGRESS REPORT; PROTONS; RESEARCH PROGRAMS; THULIUM; YTTERBIUM

37833 (NAC-AR–88-01, pp. 101-104) **Experimental nuclear physics: High-energy proton radiative capture.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

Short note. PROTON REACTIONS/capture; ANGULAR DISTRIBUTION; BORON; COBALT; CROSS SECTIONS; ENERGY SPECTRA; EXCITATION; EXCITED STATES; GAMMA RADIATION; GROUND STATES; LEGENDRE POLYNOMIALS; MEV RANGE 10-100; NAC CYCLOTRON; NITROGEN; PROGRESS REPORT; CAPTURE; PROTONS; RESEARCH PROGRAMS; SPECTROMETERS

37834 (NAC-AR–88-01, pp. 180-183) **Nuclear reactions and structure: Reactions and techniques involving fast neutrons.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

The available information on nuclear level structure is extended and information is provided about nuclear and nucleon interactions. The use of neutrons as probe or reaction product is a feature of these research items. 2 figs., 11 refs., 1 tab.

37835 (NAC-AR–88-01, pp. 184-190) **Nuclear reactions and structure: Charged-particle induced reactions.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

A more complete data base for deriving level parameters for specific nuclei is provided by using charged-particle induced reactions. (α,pγ) reactions on ^{40}Ca, ^{52}Cr, ^{19}F, ^{26}Mg, ^{48}Ti and ^{51}V at Eα = 12 MeV have been used to excite levels in ^{43}Sc, ^{55}Mn, ^{22}Ne, ^{29}Al, ^{51}V and ^{54}Cr. Gamma rays were observed in coincidence with associated protons using a multiparameter data acquisition system. 5 figs., 9 refs., 1 tab.

37836 (ORNL–6578) **Physics Division progress report for period ending September 30, 1989.** Livingston, A.B. (ed.). Oak Ridge National Lab., TN (USA). Mar 1990. 288p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012022. Available from NTIS, PC A13/MF A01; OSTI; INIS; GPO Dep.

This report discusses topics in the following areas: Holifield heavy ion research; Experimental Nuclear physics; The Uniser program; Experimental Atomic Physics; Theoretical Physics; Laser and electro-optics lab; High Energy Physics; compilations and evaluations; and accelerator design and development. (FI)

37837 (ORNL/FTR–2925) **[Cooperative research in the area of nuclear physics]: Foreign trip report, May 13–June 12, 1988.** Harvey, J.A. Oak Ridge National Lab., TN (USA). 27 Jun 1988. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012366. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler spent four weeks at the Japan Atomic Energy Research Institute (JAERI), Japan under the cooperative research agreement on nuclear physics between JAERI and MMES and also under the Foreign Researcher Inviting Program. The goal of the visit was to get the complex computer program SAMMY operating on the VAX 780 computer at the Tandem Laboratory, also on the main computer (IBM type) at JAERI. A few limited energy regions of the new ORELA high-resolution ^{238}U transmission data were analyzed at JAERI to confirm that the program was operating correctly. The traveler presented a seminar on recent research and developments at ORELA, held discussions on the neutron programs at the Tandem and Linac at JAERI, learned about their progress on the production of slow positron beams and on free electron lasers, and visited the JPDR Decommissioning Demonstration Program and the large Tokamak Fusion Experimental device JT-60. At the Mito Conference valuable discussions were held on the present status and future needs of resonance parameters of ^{238}U, on nonstatistical spacing distributions and on systematics of neutron strength functions. To satisfy the future nuclear data needs, continued international cooperation is essential for measurements, analyses, evaluations, and testing.

37838 (ORNL/FTR–3635) **[Understanding the variety of nuclear excitations]: Foreign trip report, May 19–26 1990.** Beene, J.R. Oak Ridge National Lab., TN (USA). 4 Jun 1990. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012744. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The purpose of this foreign travel was to present an invited paper on "Giant Resonance Decay Experiments" at the Third International Spring Seminar on Nuclear Physics held at Ischia, Italy. The traveler also met with members of the nuclear physics group from the University of Milan to lay groundwork for future collaborative experiments.

37839 (RCNP-P–107, pp. 150-157) **The importance of gamma-ray measurement in nuclear reaction research.** Kato, Syohei (Osaka Univ., Toyonaka (Japan). Faculty of Science). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

High spin states can be possibly produced by nucleon transfer processes in heavy ion reactions at the incident energy near 10 MeV/nucleon. Theoretical predictions are explained and an experiment recently performed is described. An importance of gamma-ray measurements as well as particle detections is stressed. (author).

37840 (RCNP-P–107, pp. 158-164) **High resolution investigation of giant resonances.** Fujita, Y. (Osaka Univ., Toyonaka (Japan). Coll. of General Education). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

A giant resonance is usually observed as a bump structure. Recently, however, high-resolution inelastic scattering experiments have succeeded in resolving the bump into many levels at the excitation energy below 15 MeV where the natural decay width is not wide. The low-energy octupole resonance have been observed as clustering L = 3 states around the excitation energies 6-9 MeV in many nuclei. The L = 2 states and L = 0 states, which are most likely the lower tails of giant quadrupole resonance and giant monopole resonance, have been observed in a few nuclei. Clustering L = 4 states have also been observed overlapping with the low-energy octupole resonance. (author).

6512 Nuclear Properties and Reactions, A = 1-5, Experimental

37841 (CEA-CONF–9892) **The polarization observables and the short range deuteron structure.** Garcon, M. CEA Centre

d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie. 1989. 6p. (In French). (CONF-8905282–: 5. Saturne meeting, Piriac (France), 16-20 May 1989). Order Number DE90500827. Available from NTIS (US Sales Only), PC A02/MF A01.

We will present two experiments which address the question of the deuteron structure at short distance: the first one, the measurement of tensor polarization in elastic electron-deuteron scattering, was performed at the Bates Linear Accelerator Center; the second one, the break-up of high energy polarized deuterons on hydrogen, has recently started at the Laboratoire National Saturne. In both cases, the wave function is probed at internal momenta up to 500 MeV/c.

37842 (KEK–89-12, pp. 51-58) **Electrodisintegration of deuteron at threshold.** Ohtsubo, H. (Osaka Univ., Toyonaka (Japan). Dept. of Physics). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Sep 1989. (CONF-8810498–: Workshop on the experiments by polarized proton and electron beams, Tsukuba (Japan), 27-28 Oct 1988). In *Proceedings of the workshop on the experiments by polarized proton and electron beams.* Order Number DE90777829. Available from NTIS (US Sales Only), PC A11/MF A01.

The electrodisintegration of deuteron at threshold was studied by investigating effects of nuclear constituents other than nucleons. For this purpose, we start from a model Lagrangian for the hadronic system, which includes baryons and bosons, construct nuclear force and electromagnetic current for nucleons with the one-boson-exchange. The relativistic corrections to the nuclear force and current are taken into account. At the same time, another important effect, i.e., Lorentz boost of nuclear wave function is also investigated with special care. These relativistic effects are found to be appreciably large at high momentum transfer region in conformity of the experimental data. (author).

37843 (KEK–89-12, pp. 145-155) **Recent photoreaction experiments at 1.3 GeV Tokyo ES.** Maruyama, Koichi (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Sep 1989. (CONF-8810498–: Workshop on the experiments by polarized proton and electron beams, Tsukuba (Japan), 27-28 Oct 1988). In *Proceedings of the workshop on the experiments by polarized proton and electron beams.* Order Number DE90777829. Available from NTIS (US Sales Only), PC A11/MF A01.

The recent status of the 1.3 GeV electron synchrotron (ES), INS, Univ. of Tokyo, is reviewed. During a period of this three years a new high duty-cycle (10-20 %) tagged γ beam channel was constructed, the development of a large-acceptance spectrometer, TAGX, was successfully completed, and γd and γ^{4}He experiments were performed. Short discussions on the preliminary results of both experiments are presented. (author).

37844 (KEK–89-13, pp. 44-56) **Polarized 3He gas target.** Mori, Yoshiharu (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1989. (In Japanese). (CONF-8903201–: 2. KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons, Tsukuba (Japan), 11 Mar 1989). In *The 2nd KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons.* Order Number DE90760025. Available from NTIS (US Sales Only), PC A07/MF A01.

The report briefly outlines a technique for nuclear polarization of ^{3}He, which is based on optical pumping by laser. Much attention has recently been drawn to this technique. To polarize the nuclear spin of an atomic nucleus, atomic hyperfine interaction is generally used to select a specific nuclear spin state. The present technique is also based on this mechanism. Two different processes are available: direct use of optical pumping between different hyperfine structural levels (direct process) and the use of spin exchange reaction caused by polarizing other atoms by optical pumping (indirect process). There are some factors that can have an adverse effect on optical pumping, affecting the polarity and atomic density. Such factors include the relaxation between two ground states and radiation trapping. In the former, exchange reaction occurs between the two states to decrease the optical pumping efficiency. Large power laser is required to eliminate it. In the latter, photons resulting from natural emission during optical pumping are re-absorbed by the polarized atoms. The mechanism of and some problems with the direct and indirect processes are also discussed briefly. (N.K.).

37845 (NAC-AR–88-01, pp. 98-100) **Experimental nuclear physics: The reaction sup 4He(p,p'1X) for X=p,d,t,sup 3He at an incident energy of 100 MeV.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

Short note. HELIUM 4 TARGET/proton reactions; CROSS SECTIONS; DEUTERONS; HELIUM; KNOCK-OUT REACTIONS; MEV RANGE 100-1000; NAC CYCLOTRON; NUCLEONS; PROGRESS REPORT; PROTON BEAMS; PROTONS; RESEARCH PROGRAMS; TRITONS

37846 (RCNP-P–107, pp. 17-25) **pd-^{3}He $\pi^0(t\pi^+)$ reaction and NNΔ resonance.** Ueda, Tamotsu (Osaka Univ., Toyonaka (Japan). Faculty of Engineering Science). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

An experimental investigation of possible NNΔ resonance or quasi-bound state with J^P=5/2$^+$ is proposed for the RCNP cascade plan on the basis of the following theoretical results. A relativistic and unitary theory for the systems of NNN - πNNN in the Δ production energy region is presented. The systems are approximated by the plural three- and two-body systems which couple through multi-channel two-body interactions. A Faddeev-type equation is given in the form of one-variable integral equation in the three dimensions, while equivalent to the four-dimensional convariant form. The equation describes all the reactions among the Nd,^{3}He(t)π, NNN and Ndπ systems in a unified way. An application is made to pd - ^{3}He $\pi^0(t\pi^+)$ reaction with the approximation that the NNΔ system dominates in the intermediate state through the J^P = 2$^+$ isotriplet-dibaryonic two-body interaction. A remarkable finding is that the J^P = 5/2$^+$ amplitude makes an anticlockwise loop in the Argand plot with its magnitude maximum about 30 MeV below the NNΔ threshold, suggesting the existence of a quasi-bound state of the NNΔ system. Furthermore, the origin for a spike structure in the energy dependence of the tensor polarization of deuteron at T_d=400-600MeV is explained. (author).

37847 (RCNP-P–107, pp. 165-173) **Nuclear physics through charge-exchange reactions.** Orihara, Hikonojo (Tohoku Univ., Sendai (Japan). Cyclotron and Radioisotope Center). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

Connected with spin-isospin excitation in nuclei, the charge-exchange reaction has been extensively studied through (p,n) and (^{3}He,t) experiments etc, while the data for the (n,p) reaction are limited to a few cases due to the experimental difficulties. In this report, we discuss some topics on spin-isospin excitations in nuclei so far reported based on the studies at low and intermediate energies to facilitate the cyclotron-cascade project at RCNP. These topics contain the Gamow-Teller (GT) transitions studied by beta-decay and (p,n) experiments, $0^+ \rightarrow 0^-$ transition and longitudinal spin response, stretched state excitation, and spin-isospin excitation by other than (p,n) and (n,p) reactions. A feasibility study for the (n,p) reaction on sd-shell nuclei is presented. (author).

37848 **Comment on "Cluster-impact fusion".** Cecil, F.E. (Colorado School of Mines, Golden, Colorado 80401 (USA)); McNeil, J.A. *Physical Review Letters (USA),* 64(18): 2210 (30 Apr 1990). DOE Contract FG02-87ER40342.

A Comment on the Letter by R. J. Beuhler, G. Friedlander, and L. Friedman, Phys. Rev. Lett. 63, 1292 (1989).

37849 **Beuhler, Friedman, and Friedlander reply.** Beuhler, R.J. (Department of Chemistry, Brookhaven National Laboratory,

Upton, New York 11973 (USA)); Friedman, L.; Friedlander, G. *Physical Review Letters (USA)*, 64(18): 2211 (30 Apr 1990).

The comment by Cecil and McNeil is shown to be irrelevent.(AIP)

6513 Nuclear Properties and Reactions, A = 6-19, Experimental

37850 (ANU-P–1019) **Study of ^{19}N and ^{21}O by multinucleon transfer.** Catford, W.N.; Fifield, L.K.; Orr, N.A.; Woods, C.L. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. May 1989. 42p. Order Number DE90630985. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Accepted for publication in Nucl. Phys., A.

The multinucleon transfer reactions ^{18}O(^{18}O,^{17}F)^{19}N and ^{18}O(^{18}O,^{15}O)^{21}O have been studied at a beam energy of 117 MeV and a mean reaction angle of 10 deg.. The same reactions, but detecting the neutron-rich ejectiles, have also been studied at a mean angle of 4.5 deg. . Excitation energies for low-lying levels in the two T_z= 5/2 nuclei ^{19}N and ^{21}O have been derived. The correspondence between the observed levels and those predicted by 0$\kappa\omega$ shell model calculations is discussed. The proposed level assignments are deduced by analogy with results from the ^{16}O(^{18}O,^{17}F)^{17}N and ^{16}O(^{18}O,^{15}O)^{19}O reactions, which were also studied in the present work, and are supported by calculations employing a semiclassical reaction model. 31 refs., 12 figs., 3 tabs.

37851 (NAC-AR–88-01, pp. 74-79) **Experimental nuclear physics: Model calculations for continuum yields induced by 200MeV protons on four different targets.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988*. Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

Calculations obtained from four different models appropriate to the pre-equilibrium part of the (p,p'1) spectrum are compared with each other to determine to what extent the shapes of continuum spectra induced by 200 MeV protons on a number of targets are reproduced by the models. Inclusive (p,p'1) spectra were measured for the targets ^{12}C, ^{27}Al, ^{58}Ni and ^{197}Au at 20 degrees (lab). The models are discussed. 5 figs., 6 refs., 1 tab.

37852 (RCNP-P–107, pp. 180-188) **Two-nucleon correlations in ^{14}C through (p,t) reaction.** Yasue, M. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'*. Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

The ^{14}C(p,t)^{12}C reaction was studied at E_p = 40.3 MeV in the region of excitation energy E_x = 0-19 MeV. The data were analyzed within the framework of exact-finite-range second-order DWBA calculations using 0p-shell model wave functions. The transitions to T = 0 states of natural parity were found to have 3 times larger enhancement than those to T = 1 states. Angular shapes of cross sections for the 1$^+$ states were reproduced by including two-step processes such as (p-d-t) and (p,t) (t,t') with finite range effects, but their absolute values were underestimated in the present analysis. The (p,t) transitions to the 3$^-$ and 4$^+$ states, which are forbidden by the direct pickup process in the 0p-shell model space, were also investigated. The transition to the α-cluster-like 7.65 MeV 0_2^+ state was explained reasonably by a multi-step process via the 4.44 MeV 2$^+$ state of ^{12}C. (author).

37853 **Angular momentum dependent absorption in ^{6}Li scattering.** Trcka, D.E. (Department of Physics, Florida State University, Tallahassee, Florida 32306 (US)); Frawley, A.D.; Kemper, K.W.; Robson, D.; Fox, J.D.; Myers, E.G. *Physical Review, C (Nuclear Physics) (USA)*, 41(5): 2134-2146 (May 1990).

Measurements are reported for (a) 50 MeV ^{6}Li+^{12}C elastic and inelastic scattering to the 2$^+$ (4.44 MeV), 0$^+$ (7.65 MeV), and 3$^-$ (9.64 MeV) states in ^{12}C, (b) 20 MeV ^{6}Li+^{12}C elastic scattering, (c) 50 MeV ^{6}Li+^{16}O elastic and inelastic scattering to the unresolved 0$^+$/3$^-$ (6.05/6.13 MeV) and 2$^+$/1$^-$ (6.92/7.12 MeV) states in ^{16}O, and (d) 50 MeV ^{6}Li+^{9}Be elastic and inelastic scattering to the 5/2$^-$ (2.43 MeV) state in ^{9}Be. Data were measured out to approximately 100°$_{c.m.}$. A mid-angle plateau characteristic of ^{6}Li scattering in the 5–10 MeV/nucleon energy range is confirmed in the ^{12}C and ^{16}O scattering but is not so apparent in the ^{9}Be scattering.

37854 **Analysis of pion scattering to stretched states in ^{60}Ni and other nuclei using Woods-Saxon wave functions.** Clausen, B.L. (Nuclear Physics Laboratory, Department of Physics, University of Colorado, Boulder, Colorado 80309 (USA)); Brack, J.T.; Braunstein, M.R.; Kraushaar, J.J.; Loveman, R.A.; Peterson, R.J.; Ristinen, R.A.; Lindgren, R.A.; Plum, M.A. *Physical Review, C (Nuclear Physics) (USA)*, 41(5): 2246-2256 (May 1990).

Inelastic scattering of 162 MeV π^- and π^+ was used to study the previously known J^π=8$^-$ stretched transitions in ^{60}Ni. A consistent analysis of data from electron and pion scattering to stretched states using both harmonic oscillator and Woods-Saxon wave functions (unbound as necessary) was performed for ^{60}Ni and three other nuclei: ^{14}C, ^{28}Si, and ^{54}Fe. The experimental pion scattering cross sections were reproduced by distorted-wave impulse approximation calculations using wave functions from (*e*,*e'*) with a normalization factor *N* that generally varied from 1 to 5. The ratio of the total isoscalar to the total isovector strength ranged from 0.2 to 1.2. The use of Woods-Saxon wave functions in the analysis did not significantly improve the fits to the angular distributions.

37855 **Scattering of polarized protons from ^{6}Li at 200 MeV.** Glover, C.W. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831 (USA)); Foster, C.C.; Schwandt, P.; Comfort, J.R.; Rapaport, J.; Taddeucci, T.N.; Wang, D. *Physical Review, C (Nuclear Physics) (USA)*, 41(6): 2487-2503 (Jun 1990). DOE Contract AC05-84OR21400.

New cross section and analyzing power data are presented for elastic and inelastic scattering of 200 MeV protons from ^{6}Li. The elastic data are well described by a standard, spherical, 12-parameter phenomenological Woods-Saxon (WS) optical potential. Microscopic folding-model optical potentials, obtained by convoluting free and Pauli-corrected effective nucleon-nucleon (*NN*) interactions with ^{6}Li ground-state densities constrained by electromagnetic data, produce satisfactory descriptions of the elastic data. The effects of the spin-spin optical potential, estimated via the distorted wave approximation (DWA), are small but not negligible. The inelastic transitions leading to the 3$^+$,*T*=0 state at 2.18 MeV and the 0$^+$,*T*=1 state at 3.56 MeV are also examined within the framework of the microscopic folding model using the DWA. Transition potentials are generated by convoluting the two effective *NN* interactions considered with target transition densities constrained by weak and electromagnetic data. These are employed in DWA calculations using both folded optical potentials consistent with the transition potentials and the WS optical potential. The self-consistent calculation with the Pauli-corrected interaction provides a good description of the data for the 3$^+$ excitation. The results for the 0$^+$ excitation provide a clear indication that shell model configurations outside the *p* shell are important for a complete description of this transition.

37856 **Measurement of the half-life of ^{8}Li.** Sale, K.E. (Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550 (USA)); Wang, T.; Boyd, R.N.; Mathews, G.J.; Heikkinen, D.W.; Roberts, M.L.; Islam, M.S.; Corn, P.B. *Physical Review, C (Nuclear Physics) (USA)*, 41(5): 2418-2420 (May 1990). DOE Contract W-7405-ENG-48.

We present results of a measurement of the beta-decay half-life of ^{8}Li using an ^{8}Li radioactive ion beam implanted in a Si detector. The half-life is found to be 840.3±0.9 ms.

37857 **Effective interactions and nuclear structure using 180 MeV protons. I. ^{16}O(*p*,*p'*).** Kelly, J.J.; Finn, J.M.; Bertozzi, W.; Buti, T.N.; Hersman, F.W.; Hyde-Wright, C.; Hynes, M.V.; Kovash, M.A.; Murdock, B.; Ulmer, P. *Physical Review, C (Nuclear Physics) (USA)*, 41(6): 2504-2513 (Jun 1990).

Differential cross sections and analyzing powers for scattering of 180 MeV protons by ^{16}O have been measured for all narrow states below 12.1 MeV of excitation. Medium modifications to the effective interaction for normal-parity isoscalar transitions were studied using transition densities determined by electron scattering to minimize nuclear structure uncertainties. An empirical effective interaction, guided by nuclear matter theory, was fitted to inelastic scattering

data for six states simultaneously. Distorted waves were generated from self-consistent optical potentials computed from the same effective interaction. The isoscalar effective interaction determined by this procedure provides a good global fit to the inelastic scattering data and is consistent with elastic scattering data that were not included in the fit. The results are consistent with earlier results for 135 MeV and show that the effective interaction is suppressed at low density but is less density dependent than predicted by nuclear matter theory and the local density approximation. These comparisons suggest effects in finite nuclei beyond the local density approximation. Finally, we compare data for 0^- and 2^- states at both 135 and 180 MeV with representative calculations.

37858 Zero-degree cross sections for the ^{7}Li(p,n)^{7}Be(g.s.+0.43-MeV) reaction in the energy range 80–795 MeV. Taddeucci, T.N.; Alford, W.P.; Barlett, M.; Byrd, R.C.; Carey, T.A.; Ciskowski, D.E.; Foster, C.C.; Gaarde, C.; Goodman, C.D.; Goulding, C.A. *Physical Review, C (Nuclear Physics) (USA)*, 41(6): 2548-2555 (Jun 1990).

Differential-cross-section distributions for the ^{7}Li(p,n)^{7}Be(g.s.+0.43-MeV) reaction have been measured for E_p=80, 120, 160, 200, 494, 644, and 795 MeV. These distributions have been integrated and normalized to independent values for the total cross section obtained from parametrizations of ^{7}Li(p,n) activation measurements. Zero-degree cross sections obtained from this normalization are reported.

37859 ^{12}C(n,γ_0)^{13}C cross section in the 8–11 MeV region. Hakansson, A. (The Svedberg Laboratory, Uppsala University, Uppsala (Sweden)); Lindholm, A.; Nilsson, L.; Blomgren, J.; Soederman, P.; Drake, D.M.; Wender, S.A.; Olsson, N. *Physical Review, C (Nuclear Physics) (USA)*, 41(6): 2556-2559 (Jun 1990).

To resolve the discrepancy between two sets of ^{12}C(n,γ_0)^{13}C cross-section data, the reaction has been reinvestigated in the neutron energy region between 8 and 11 MeV. The present and previous data sets are compared with each other and with existing data on the ^{13}C(γ,n_0)^{12}C cross section using the principle of detailed balance. The present data are in agreement with one of the previous data sets, which has an energy dependence in good agreement with that of the (γ,n_0) data. These (n,γ_0) cross-section data are, however, approximately a factor of 2 smaller than the (γ,n_0) cross sections over the entire neutron energy range of the comparison (from 7 to 20 MeV).

37860 Negative pion-nucleus elastic scattering at 30 and 50 MeV. Seth, K.K. (Northwestern University, Evanston, Illinois 60208 (USA)); Barlow, D.; Iversen, S.; Kaletka, M.; Nann, H.; Smith, D.; Artuso, M.; Burleson, G.; Blanpied, G.; Daw, G. *Physical Review, C (Nuclear Physics) (USA)*, 41(6): 2800-2808 (Jun 1990).

Differential cross sections for the elastic scattering of 30 and 50 MeV π^- by nuclei ranging from ^{12}C to ^{208}Pb have been measured using a range spectrometer. Comparison is made with the predictions of a recent optical-model calculation and the general nature of discrepancies is discussed.

37861 ^{12}C(^{28}Si,X)^{11}C cross section at 13.4 GeV nucleon. Winger, J.A. (Ames Laboratory, Iowa State University, Ames, Iowa 50011 (USA)); Hill, J.C.; Cumming, J.B.; Beavis, D. *Physical Review, C (Nuclear Physics) (USA)*, 41(6): 2931-2932 (Jun 1990). DOE Contract AC02-76CH00016.

The ^{12}C(^{28}Si,X)^{11}C cross section was measured for 13.4-GeV/nucleon ^{28}Si ions. Beam intensities were determined with a two-element counter telescope, and the ^{11}C activity induced in thin and thick plastic scintillator targets was assayed by internal scintillation counting. The cross section corrected to zero target thickness is 73.5±3.5 mb. This value is compared with similar measurements for relativistic projectiles at 1–2 GeV/nucleon.

6514 Nuclear Properties and Reactions, A = 20-38, Experimental

Refer also to citation(s) 37708, 37850, 37851, 37854, 37932

37862 Additional evidence for fusion-fission in ^{32}S+^{24}Mg reactions: Division of excitation energy and spin in the fission fragments. Sanders, S.J. (Department of Physics and Astronomy, University of Kansas, Lawrence, Kansas 66045 (USA)— Argonne National Laboratory, Argonne, Illinois 60439 (USA)); Back, B.B.; Janssens, R.V.F.; Kovar, D.G.; Habs, D.; Henderson, D.; Khoo, T.; Korner, H.; R *Physical Review, C (Nuclear Physics) (USA)*, 41(5): 1901-1905 (May 1990). DOE Contract FG02-89ER40506.

We have measured γ rays in coincidence with ^{12}C fragments from the fission of ^{56}Ni produced with the ^{32}S+^{24}Mg reaction at E_{lab}=140 MeV. These data provide insight into the fission process in this light system by giving information about the energy and spin sharing between the ^{12}C and ^{44}Ti fragments, and the spin alignment of the lighter, ^{12}C fragment. The spin transfer and the nuclear "temperature" at scission deduced from this measurement can be related to the compound-nucleus spin and potential energy at scission. The results indicate a statistical decay process consistent with the predictions of the transition-state model employing newer estimates of the spin- and mass-asymmetry-dependent saddle-point energies and corresponding shapes. No evidence is found for the spin alignment of the ^{12}C fragments, contrary to what might be expected for a deep-inelastic scattering origin of the fully energy damped yields.

37863 Preequilibrium (p,n) reaction as a probe for the effective nucleon-nucleon interaction in multistep direct processes. Scobel, W. (I. Instituut fuer Experimentalphysik, Universitaet Hamburg, D-2000 Hamburg 50, (Federal Republic of Germany)); Trabandt, M.; Blann, M.; Pohl, B.A.; Remington, B.A.; Byrd, R.C.; Foster, C.C.; Bonetti, R. *Physical Review, C (Nuclear Physics) (USA)*, 41(5): 2010-2020 (May 1990).

The spectral continua E_n≥30 MeV of neutrons from the reactions ^{27}Al, ^{90}Zr, ^{208}Pb(p,xn) have been measured for E_p=120 and 160 MeV and angles $0° \leq \theta \leq 145°$. Angular distributions can be explained quantitatively in absolute values and shapes over five orders of magnitude as statistical multistep direct emission in which up to six steps are involved with significant contributions. The strength V_0 of the effective nucleon-nucleon interaction applied shows a systematic dependence on the projectile energy $E_p \leq 160$ MeV that is consistent with that of spectroscopic factors for single step distorted-wave Born approximation results for transitions to low-lying states. The data also agree well with predictions of a recent phenomenological parametrization.

37864 Spin alignment and resonance behavior in the ^{24}Mg+^{24}Mg system. Wuosmaa, A.H. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104 (USA)); Zurmuehle, R.W.; Kutt, P.H.; Pate, S.F.; Saini, S.; Halbert, M.L.; Hensley, D.C. *Physical Review, C (Nuclear Physics) (USA)*, 41(6): 2666-2680 (Jun 1990). DOE Contract AC05-84OR21400.

We have performed detailed particle-γ and particle-γ-γ angular correlation measurements for two strong resonances observed in the elastic and inelastic scattering of ^{24}Mg+^{24}Mg. These data provide us with spectroscopic information relatively uncontaminated by nonresonant amplitudes, and allow spin assignments of J^π=36$^+$ for two resonances at $E_{c.m.}$=45.70 and 46.65 MeV. The angular correlation data for the mutual 2$^+$ inelastic scattering channel suggest a dominant decay l value of l=34 for both resonances. Correlated spin alignment data for this channel confirm our expectations for the relationship between angular momentum coupling and spin alignment for these resonances. The relatively high spin values suggest a resonance configuration in which the two ^{24}Mg nuclei interact pole-to-pole, allowing the system to sustain a large amount of angular momentum. The pole-to-pole grazing picture is supported by the results of model calculations of the ^{24}Mg+^{24}Mg→^{48}Cr system.

6515 Nuclear Properties and Reactions, A = 39-58, Experimental

Refer also to citation(s) 37854, 37862

37865 Nuclear-structure effects in proton evaporation spectra. Sarantites, D.G.; Baktash, C.; Nicolis, N.G.; Garcia-Bermudez, G.; Abenante, V.; Beene, J.R.; Johnson, N.R.; Halbert, M.L.; Hensley, D.C.; McGowan, F.K. *Physical Review Letters (USA)*, 64(18): 2129-2132 (30 Apr 1990). DOE Contract FG02-88ER40406 ;AC05-84OR21400.

Energy spectra and angular distributions of evaporated protons from the reaction $^{52}Cr(^{34}S, 2p2n)^{82}Sr$ at 130 MeV were measured in coincidence with discrete γ transitions. Large shifts and changes in the shape of the proton spectra were observed when high-spin states in different rotational bands are populated. They are interpreted as due to near-yrast stretched proton emission, which preferentially populates the yrast band by subbarrier protons.

37866 Reaction $^{58}Ni(\pi^+,pp)$ at T_π+=160 MeV. Burger, W.J. (Department of Physics and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139 (USA)); Beise, E.; Gilad, S.; Redwine, R.P.; Roos, P.G.; Chant, N.S.; Breuer, H.; Ciangaru, G.; Silk, J.D.; Blanpi *Physical Review, C (Nuclear Physics) (USA),* 41(5): 2215-2228 (May 1990).

The reaction $^{58}Ni(\pi^+,pp)$ was studied with good energy resolution for an incident pion energy of 160 MeV. The angular correlation of the outgoing protons was measured for θ_{lab}=30°, 75°, and 130°. From these angular correlations the contribution from direct two-nucleon absorption was extracted. A Monte Carlo calculation modeling the absorption process in terms of initial-state scattering of the pion before absorption, two-nucleon absorption, and final-state scattering of the outgoing nucleons is compared to the data. We conclude that within this framework the two-nucleon mechanism can account for less than half of the total absorption cross section in ^{58}Ni. We report results for the low-energy coincidence proton spectra (down to 5 MeV) which suggest that most of these protons come from evaporation. Angular correlation data for the reaction $^{58}Ni(\pi^-,pp)$ are also presented.

37867 Half-lives of ^{44}Ti and ^{207}Bi. Alburger, D.E. (Brookhaven National Laboratory, Upton, New York 11973 (US)); Harbottle, G. *Physical Review, C (Nuclear Physics) (USA),* 41(5): 2320-2324 (May 1990). DOE Contract AC02-76CH00016.

An end-window gas-flow proportional counter system, including an automatic precision sample changer, was used to measure the decay of radiations from two samples of ^{44}Ti and one of ^{207}Bi. Comparison counts were taken on a ^{36}Cl standard, and the ratio of counts determined the decay. Points consisted of alternate 30-min counts on each sample and on the standard, totaling 30 h on each, and were taken at intervals of about one month. Based on 3 years of counting on the ^{207}Bi source and on one of the ^{44}Ti sources, and 1 year on the second ^{44}Ti sample, half-lives were obtained as follows: ^{44}Ti, 66.6(16) yr and ^{207}Bi, 34.9(4) yr. The ^{207}Bi value lies between the two most recently reported values. In the case of ^{44}Ti there are discrepancies with all three previous results including an Argonne accelerator mass spectroscopy value of 54.2(21) yr.

6516 Nuclear Properties and Reactions, A = 59-89, Experimental

Refer also to citation(s) 37782, 37932

37868 (RCNP-P–107, pp. 147-149) **Analyzing powers of (p vector,2p) reactions at Ep = 3.5 GeV and relativistic effects.** Hasegawa, Takeo (Miyazaki Univ. (Japan). Faculty of Engineering). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

Analyzing powers have been measured for the quasi-elastic (p,2p) reactions on C and Cu using a KEK 3.5 GeV polarized proton beam. The results show relatively larger values comparing with the ones obtained at lower than 2.8 GeV at Saturne(Saclay) and are reproduced well by the calculations based on the Relativistic Impulse Approximation with an effective nucleon mass. (author).

6517 Nuclear Properties and Reactions, A = 90-149, Experimental

Refer also to citation(s) 37863

37869 (CONF-9005221–4) **Multinucleon transfer reactions for the ^{50}Ti+^{93}Nb system at sub- and near-barrier energies.** Kim, H.J. (Oak Ridge National Lab., TN (USA)); Gomez del Campo, J.; Shapira, D.; Stelson, P.H.; Napoli, D.; Scarlassara, F.; D'Onofrio, A.; Wieleczko, J.P. Oak Ridge National Lab., TN (USA). Jun 1990. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Interface between nuclear structure and heavy-ion reaction dynamics conference; Notre Dam, IN (USA); 24-26 May 1990. Order Number DE90012730. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A significant yield of multinucleon-transfer products is observed at back angles in quasielastic reactions between ^{50}Ti and ^{93}Nb at sub- and near-barrier energies. A variety of nuclidic species that require transfers of up to four nucleons are observed for $E_{c.m.} \geq$ 103.9 MeV. The internuclear separation distance where the multinucleon-transfer products first emerge nearly coincides with the closest approach distance of the experimentally established fusion threshold energy, indicating a common origin for the fusion enhancement and multinucleon-transfer reactions.

37870 (ISN–89-39) **Influence of neutron and proton alignments on the shape of A = 120-130 transitional nuclei.** Gizon, J. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. 1989. 16p. (CONF-8904247–: 24. Zakopane school on physics, Zakopane (Poland), 16-23 Apr 1989). Order Number DE90500782. Available from NTIS (US Sales Only), PC A03/MF A01.

Relations between particle alignments and shapes are discussed for a few typical cases chosen in the A = 120-130 transitional region: shapes associated with $(\pi h_{11/2}{}^2)$ and $(\nu h_{11/2}{}^2)$ configurations, $i_{13/2}$ neutrons and superdeformations, predictions concerning band terminations.

37871 Deformation effects in the compound nucleus decay using the spin-alignment method. Nicolis, N.G. (Department of Chemistry, Washington University, St. Louis, Missouri 63130 (USA)); Sarantites, D.G.; Adler, L.A.; Dilmanian, F.A.; Honkanen, K.; Majka, Z.; Sobotka, L.G.; Li, Z.; Semkow, T.M.; Beene, J.R. *Physical Review, C (Nuclear Physics) (USA),* 41(5): 2118-2133 (May 1990). DOE Contract FG02-88ER40406.

Alpha-particle energy spectra and angular distributions with respect to the estimated spin direction of residual nuclei have been measured in heavy-ion fusion reactions. The spin direction was determined for each event by measuring the γ-ray angular correlation patterns using the Spin Spectrometer. Measurements were made for the compound nuclear systems $^{110}Sn^*$(94 MeV), $^{114}Sn^*$(80 MeV), $^{138}Nd^*$(82 MeV), $^{164}Yb^*$(67 MeV), and $^{170}Yb^*$(135 MeV) at the indicated excitation energies as a function of the alpha-particle energy and γ-ray multiplicity. The anisotropy coefficients below the evaporation Coulomb barrier show distinct differences from $^{110}Sn^*$ to $^{170}Yb^*$. These results and the shapes of the alpha-particle spectra are compared with statistical model calculations that incorporate deformation effects in the optical model transmission coefficients. The Sn* data can be explained without invoking deformation effects other than the ones included in the experimental yrast lines. However, for the heavier Yb* systems, a considerable spin-dependent deformation in the α-emission barriers is required. For these systems the α emission below the barrier is a sensitive probe for deformation that samples a broad range of excitation energies in the decay sequence.

37872 Analyzing power measurements for elastic scattering of 17 MeV neutrons from ^{120}Sn. Pedroni, R.S. (Department of Physics, Duke University, Durham, North Carolina 27706 (US)—Triangle Universities Nuclear Laboratory, Durham, North Carolina 27706); Howell, C.R.; Walter, R.L. *Physical Review, C (Nuclear Physics) (USA),* 41(6): 2929-2930 (Jun 1990). DOE Contract AC05-76ER01067.

Measurements of the analyzing power $A_y(\theta)$ have been made for the elastic scattering of neutrons from ^{120}Sn at 17 MeV. Over most of the angular range the data agree with predictions derived from the previously reported coupled-channels analysis for $^{116,120}Sn(n,n)$ of Guss *et al.*

6518 Nuclear Properties and Reactions, A = 150-189, Experimental

Refer also to citation(s) 37782, 37871

37873 (ANU-P–1041) **Intrinsic states and rotational bands in ^{177}Pt.** Dracoulis, G.D.; Fabricius, B.; Bark, R.A.; Stuchbery, A.E.; Popescu, D.G.; Kibedi, T. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. Nov 1989. 45p. Order Number DE90631009. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Accepted for publication in Nucl. Phys.

The ^{149}Sm (^{32}S,4n) ^{177}Pt reaction has been used to populate excited states in the neutron-deficient nucleus ^{177}Pt. Rotational bands based on intrinsic states assigned to the 1/2-[521], 5/2-[521] and (mixed) 7/2+ [633] Nilsson configurations have been observed. In contrast to the neighbou-ring even isotope ^{176}Pt, anomalies attributed to shape co-existence at low spin have not been observed. Implications for the deformation of ^{177}Pt are discussed together with the systematics of intrinsic states in this region, and alignments and other properties of N=99 nuclei. 37 refs., 15 figs., 3 tabs.

37874 (ANU-P–1043) **High spin states and intrinsic structure in ^{174}Os and ^{175}Os -alignments and strong interaction.** Fabricius, B. (Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics); Dracoulis, G.D.; Bark, R.A.; Stuchbery, A.E.; Kibedi, T.; Baxter, A.M. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. Nov 1989. 60p. Order Number DE90631010. Available from NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

Accepted for publication in Nucl. Phys., A.

High-spin states have been identified in ^{174}Os and ^{175}Os using (HI, xn) reactions and gamma-ray techniques. Rotational bands built on low-lying intrinsic states in ^{175}Os have been observed for the first time. The intrinsic states are identified as a mixed $i_{13/2}$ neutron state (nominally 7/2+[633]) and the 1/2-[521] and 5/2-[512] Nilsson configurations. Differences in the alignment of the two signatures of the decoupled band built on the 1/2-[521] state and the comparison between the signature splitting of routhians and B(M1)/B(E2) values in the $i_{13/2}$ band suggest softness towards gamma deformation. Crossing transitions between the negative parity bands at intermediate spin have been observed and the interaction strength derived from the branching ratios. A comparison of the properties of bands in ^{174}Os and ^{175}Os shows some expected similarities, but also surprising differences which point towards the need for a more comprehensive treatment in strong interaction cases. Depending on the choice of reference the alignment in the $i_{13/2}$ band might show degenerate BC and AD crossings at a relatively low frequency. This may be consistent with the alignment observed in the negative parity side bands in ^{174}Os. 39 refs., 16 figs., 6 tabs.

37875 (ANU-P–1048) **Conversion coefficients and yrast state spins in ^{180}Os.** Dracoulis, G.D.; Kibedi, T.; Byrne, A.P.; Fabricius, B.; Stuchbery, A.E. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. Nov 1989. 16p. Order Number DE90631011. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Accepted for publication in Nucl. Phys.

Internal conversion coefficients of transitions in ^{180}Os have been measured using a superconducting, solenoidal electron spectrometer, operated in the lens mode. The high energy resolution and efficiency allow a precise measurement of the conversion coefficients of the 528 keV yrast transition. The values obtained, α_K = 0.015 (2), α_L = 0.004(1) define pure E2 multipolarity. Taken with the measured γ-ray angular distribution, the conversion coefficient leads to an unambiguous assignment of $16^+ \rightarrow 14^+$ for the 528 keV transition. 14 refs., 5 figs., 1 tab.

37876 (ORNL/FTR–3623) **[The decay properties of neutron-deficient hafnium isotopes]: Foreign trip report, May 19, 1990–May 31, 1990.** Toth, K.S. Oak Ridge National Lab., TN (USA). 12 Jun 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012742. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The purpose of this foreign travel was to perform an experiment at the VICKSI (Van de Graff Isochron Cyclotron Kombination fuer Schwere Ionen) accelerator facility of the Han-Meitner Institute in West Berlin. The experiment, designed to examine the decay properties of neutron-deficient hafnium isotopes, was successful. Following completion of the experiment, six days were spent at the University of Goettingen discussing and analyzing the data that had been obtained. Also, a seminar was presented to the University's physics faculty and students.

37877 **Thermal and angular momentum effects in the giant-dipole-resonance decay of hot rare-earth nuclei.** Morsch, H.P. (Institut fuer Kernphysik, Kernforschungsanlage Juelich, D-5170 Juelich, (Federal Republic of Germany)); Spang, W.; Beene, J.R.; Bertrand, F.E.; Auble, R.L.; Charvet, J.L.; Halbert, M.L.; Hensley, D.C.; Lee, I.Y.; Varner, R.L. *Physical Review Letters (USA)*, 64(17): 1999-2002 (23 Apr 1990). DOE Contract AC05-84OR21400.

Recoil-γ coincidences have been measured in the reaction ^{16}O+^{159}Tb at beam energies of 300 and 400 MeV. In the γ-ray spectra corresponding to excitation energies above 140 MeV a split giant dipole resonance is observed with widths substantially smaller than found at lower excitation energy. The possible influence of excitation energy and angular momentum on this effect is discussed. The intensity ratio of the two dipole resonance components is found to change with excitation energy, indicating a transition of the nuclear shape from prolate towards oblate.

37878 **Lifetimes of high spin states in ^{181}Ir and ^{180}Os.** Kaczarowski, R. (Physics Department, University of Notre Dame, Notre Dame, Indiana 46556 (USA)); Garg, U.; Chaudhury, A.; Funk, E.G.; Mihelich, J.W.; Frekers, D.; Janssens, R.V.F.; Khoo, T.L. *Physical Review, C (Nuclear Physics) (USA)*, 41(5): 2069-2074 (May 1990). DOE Contract W-31-109-ENG-38.

The ^{150}Nd(^{35}Cl,4*n*)^{181}Ir and ^{150}Nd(^{34}S,4*n*)^{180}Os reactions have been used to study the lifetimes of high-spin states in ^{181}Ir and ^{180}Os using the recoil-distance technique. The lifetimes of four states in ^{181}Ir and three yrast states in ^{180}Os have been determined. The mean weighted values of quadrupole moments deduced for the measured rotational transitions between yrast states in ^{181}Ir and ^{180}Os, Q_0=(6.0±0.2) *e* b and Q_0=(6.1±0.4) *e* b, respectively, are equal within experimental errors.

37879 **Half-life of ^{176}Lu.** Gehrke, R.J. (Idaho National Engineering Laboratory, EG&G Idaho, Inc., P.O. Box 1625, Idaho Falls, Idaho 83415 (US)); Casey, C.; Murray, R.K. *Physical Review, C (Nuclear Physics) (USA)*, 41(6): 2878-2882 (Jun 1990). DOE Contract AC07-76ID01570.

The half-life of ^{176}Lu was deduced using Ge γ-ray spectrometry from the mass and activity of a lutetium oxide sample enriched in ^{176}Lu. The half-life was found to be $4.05\pm0.09\times10^{10}$ y. The relative intensities of the γ rays were also measured and are compared to previously reported values.

6519 Nuclear Properties and Reactions, A = 190-219, Experimental

Refer also to citation(s) 37851, 37860, 37867

37880 (CONF-900450–5) **Excitation and photon decay of giant multipole resonances.** Bertrand, F.E.; Beene, J.R. Oak Ridge National Lab., TN (USA). [1990]. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Nuclear structure in the '90's; Oak Ridge, TN (USA); 23-27 Apr 1990. Order Number DE90012415. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A brief review of the excitation of giant multipole resonances via Coulomb excitation is given which emphasizes the very large cross sections that can be realized through this reaction for both isoscalar and isovector resonances. Discussion and results where available, are provide for the measurement of the photon decay of one and two phonon giant resonances. It is pointed out throughout the presentation that the use of E1 photons as a "tag" provides a means to observe weakly excited resonances that cannot be observed in the singles spectra. 14 refs., 12 figs., 1 tab.

37881 (CONF-9004220–1) **Nucleus-nucleus collisions at 60 to 200 GeV/nucleon: Results from the WA80 experiment at CERN.** Plasil, F. (Oak Ridge National Lab., TN (USA)); Awes, T.C.;

Baktash, C.; Ferguson, R.L.; Lee, I.Y.; Saini, S.; Tincknell, M.L.; Young, G.R.; Obenshain, F.E.; Sorensen, S.P. WA80 Collaboration. Oak Ridge National Lab., TN (USA). May 1990. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International workshop on nuclear dynamics; Elba (Italy); 2-7 Apr 1990. Order Number DE90012788. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Results from ^{16}O- and ^{32}S-induced reactions obtained by the WA80 collaboration at the CERN SPS are presented with reference to global event characteristics such as collision geometry, the degree of nuclear stopping, and the energy density attained. Transverse momentum spectra of neutral pions and of direct photons are also presented. At an accuracy within 15% limits, all observed photons are accounted for by known hadronic decays. 13 refs., 8 figs., 1 tab.

37882 (UCRL–103001) **Level spin and moments of inertia in superdeformed nuclei near A = 194.** Becker, J.A. (Lawrence Livermore National Lab., CA (USA)); Roy, N.; Henry, E.A.; Yates, S.W.; Kuhnert, A.; Draper, J.E.; Korten, W.; Beausang, C.W.; Deleplanque, M.A.; Diamond, R.M. Lawrence Livermore National Lab., CA (USA). Apr 1990. 8p. Sponsored by U.S. DOE Energy Research; National Science Foundation. DOE Contract AC03-76SF00098 ;W-7405-ENG-48. (CONF-900450–6: Nuclear structure in the '90's, Oak Ridge, TN (USA), 23-27 Apr 1990). Order Number DE90013477. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Experimental transition energies in the superdeformed (SD) bands near A = 190 are least-squares fit to rotational model formulae in order to extract level spin. The data set includes 16 SD bands, which show no evidence of either irregular behavior near the bottom of the bands or abrupt angular momentum alignment at low $\hbar\omega$. The 9 transitions lowest in energy in each band are well described by the formulae. The fitted spin of the final state in the γ-ray cascade is within $\pm 0.1\hbar$ of an integer or half-odd integer for 13 of the bands. The weight of the evidence suggests that meaningful level spins corresponding to these transitions can be inferred. The moment of inertia at $\omega = 0$ is correlated, with I = 88.3(5)$\hbar^2$/MeV and I = 93.4(5)$\hbar^2$/MeV for the strong and weak bands, respectively. 19 refs., 2 figs., 2 tabs.

37883 Spin alignment in superdeformed Hg nuclei. Stephens, F.S. (Lawrence Berkeley Laboratory, Nuclear Science Division, 1 Cyclotron Road, Berkeley, California 94720 (US)); Deleplanque, M.A.; Draper, J.E.; Diamond, R.M.; Beausang, C.W.; Korten, W.; Kelly, W.H.; Azaiez, F.; Becker, J.A.; Henry, E.A. *Physical Review Letters (USA)*, 64(22): 2623-2626 (28 May 1990). DOE Contract AC03-76SF00098 ;W-7405-ENG-48.

One of the superdeformed rotational bands in ^{194}Hg has transition energies (rotational frequencies) that are equal within about 0.1% to those of the (only known) band in ^{192}Hg. This excited (two-quasiparticle) band in ^{194}Hg has an aligned spin of $(1.00\pm0.04)\hbar$ relative to the very similar band in ^{192}Hg, suggesting an interpretation in terms of aligned pseudo (intrinsic) spin. The implied pseudospin symmetry may be a clue as to why the rotational frequencies are so similar.

6520 Nuclear Properties and Reactions, A = 220 and Above, Experimental

Refer also to citation(s) 37891, 37892

37884 (ANU-P–1042) **Fission fragment angular distributions following transfer reactions for $^{232}Th + ^{16}O$.** Lestone, J.P.; Leigh, J.R.; Newton, J.O.; Wei, J.X. Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics. Oct 1989. 33p. Order Number DE90631029. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Accepted for publication in Nucl. Phys., A.

Fission fragment angular distributions following transfer have been measured for $^{232}Th + ^{16}O$ at energies of 86 MeV and 90 MeV. The distributions for a given scattering angle are strongly peaked forward and backward of the recoil direction. However when all recoil angles are considered, the integrated angular distribution, relative to the beam direction, is less pronounced than that observed when both fusion-fission and transfer-fission are included in the measurement. Thus the anomalously large fusion spin distribution extracted from such measurements persists, even when the effects of transfer are taken into account. However, our measurements suggest that transfer-fission can have large anisotropies when appropriate reaction Q values are involved. Then, in a singles measurement, a decrease in anisotropy, with increasing energy, may be expected near the fusion barrier. Such behaviour has been observed for $^{232}Th + ^{19}F$. The study of particle-fragment correlations may prove to be a useful technique for evaluating the optimal angular momentum transfer in heavy ion transfer reactions on deformed nuclei. 19 refs., 9 figs., 3 tabs.

37885 (ORNL/TM–11490) **Resonance analysis of the ^{239}Pu neutron cross sections in the energy range 300 to 2000 eV.** Derrien, H.; de Saussure, G. Oak Ridge National Lab., TN (USA). Jun 1990. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90011267. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A recent high-resolution measurement of the neutron fission cross section of ^{239}Pu has allowed the extension from 1 to 2 keV of a previously reported resonance analysis of the neutron cross sections, and an improvement of the previous analysis in the range 0.3 to 1 keV. Extensive tabular and graphical comparisons between results of measurements and calculations with the resonance parameters are given. The evaluation in ENDF-6 format is available at the nuclear data centers (NNDC at Brookhaven National Laboratory and NEADB at Saclay). 19 refs., 8 figs., 5 tabs.

37886 (ORNL/TM–11547) **Resonance analysis and evaluation of the ^{235}U neutron induced cross sections.** Leal, L.C. Oak Ridge National Lab., TN (USA). Jun 1990. 92p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90011284. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

Thesis submitted by L.C. Leal to Univ. of Tennessee, Knoxville.

Neutron cross sections of fissile nuclei are of considerable interest for the understanding of parameters such as resonance absorption, resonance escape probability, resonance self-shielding,and the dependence of the reactivity on temperature. In the present study, new techniques for the evaluation of the ^{235}U neutron cross sections are described. The Reich-Moore formalism of the Bayesian computer code SAMMY was used to perform consistent R-matrix multilevel analyses of the selected neutron cross-section data. The Δ_3-statistics of Dyson and Mehta, along with high-resolution data and the spin-separated fission cross-section data, have provided the possibility of developing a new methodology for the analysis and evaluation of neutron-nucleus cross sections. The results of the analysis consists of a set of resonance parameters which describe the ^{235}U neutron cross sections up to 500 eV. The set of resonance parameters obtained through a R-matrix analysis are expected to satisfy statistical properties which lead to information on the nuclear structure. The resonance parameters were tested and showed good agreement with the theory. It is expected that the parametrization of the $_{235}U$ neutron cross sections obtained in this dissertation represents the current state of art in data as well as in theory and, therefore, can be of direct use in reactor calculations. 44 refs., 21 figs., 8 tabs.

37887 Heavy actinide production from the interactions of ^{40}Ar with ^{248}Cm and a comparison with the ^{44}Ca-^{248}Cm system. Leyba, J.D.; Henderson, R.A.; Hall, H.L.; Gannett, C.M.; Chadwick, R.B.; Czerwinski, K.R.; Kadkhodayan, B.A.; Kreek, S.A.; Haynes, G.R.; Gregorich, K.E. *Physical Review, C (Nuclear Physics) (USA)*, 41(5): 2092-2102 (May 1990). DOE Contract AC03-76SF00098.

Excitation functions have been measured for isotopes of Bk, Cf, Es, and Fm produced from the interactions of 207- to 286-MeV ^{40}Ar ions with ^{248}Cm. The measured isotopic distributions were found to be essentially symmetric with full widths at half maximum between 2.0 and 3.5 mass units. These results are comparable to those obtained in previous studies using $^{40,44,48}Ca$ with ^{248}Cm. The maxima of the isotopic distributions from the ^{40}Ar-^{248}Cm system show shifts, to both heavier and lighter mass numbers, of 0 to 2 mass units relative to the corresponding maxima of the isotopic distributions from the $^{40,44,48}Ca$-^{248}Cm systems.

37888 Microscopic study of the ^{238}U-^{238}U system and anomalous pair production. Berger, J.F. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550 (US)); Anderson, J.D.; Bonche, P.; Weiss, M.S. *Physical Review, C (Nuclear Physics) (USA)*, 41(6): 2483-2486 (Jun 1990). DOE Contract W-7405-ENG-48.

Constrained Hartree-Fock-Bogolyubov calculations have been performed to simulate the collision of two ^{238}U nuclei at low energies (≈5.5 MeV/nucleon). These *ab initio* calculations indicate that electromagnetic transitions of energies between 1.5 and 1.8 MeV can be expected in the center of mass system of the colliding nuclei. These calculations are also consistent with the observed laboratory energy dependence and *Z* dependence of the anomalous pair production.

37889 Excitation and fission decay of ^{238}U using the (^{17}O,$^{17}O'$) reaction. Auble, R.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831 (USA)); Beene, J.R.; Bertrand, F.E.; Blankenship, J.L.; Horen, D.J.; Lisantti, J.; Varner, R.L.; D'Onofrio, A. *Physical Review, C (Nuclear Physics) (USA)*, 41(6): 2620-2623 (Jun 1990). DOE Contract AC05-84OR21400.

The inelastic scattering of 375 MeV ^{17}O projectiles was used to study the giant resonance region in ^{238}U. The energy, width, and strength of the giant quadrupole resonance (GQR) were extracted from singles spectra and fission probabilities were deduced from singles and coincidence data. Angular correlations between fission fragments and inelastically scattered particles were measured to search for evidence of *K* conservation in the fission decay of the GQR.

6530 Nuclear Theory

Refer also to citation(s) 37836, 37884, 37993

37890 (CEA-CONF–9893) **Inelastic events in nucleon-nucleon scattering experiments.** Wellers, F. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Moyenne Energie. 1989. 12p. (In French). (CONF-8905282–: 5. Saturne meeting, Piriac (France), 16-20 May 1989). Order Number DE90500829. Available from NTIS (US Sales Only), PC A03/MF A01.

The phenomenological aspects of the inelastic event occurring in the nucleon-nucleon scattering, are analyzed. The Saturne experiment specific possibilities. (NN→NNπ, NN→NNη, NN→NNπ π), are underlined.

37891 (CENBG–89-16) **Classical model for α-particle emission during nuclear fission.** Carjan, N. (Bordeaux-1 Univ., 33 - Gradignan (FR). Centre d'Etudes Nucleaires); Leroux, B.; Weingartner, K.; Theobald, J. Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires. 1989. 7p. (CONF-890406–: International Conference 50. Years with Nuclear Fission, Gaithersburg, MD (USA), 25-28 Apr 1989). Order Number DE90500784. Available from NTIS (US Sales Only), PC A02/MF A01.

The classical motion of an α cluster inside the fissioning nucleus ^{232}Th (simulating the α accompained fission of ^{236}U) is calculated. For certain initial conditions. the α trajectories escape the region of nuclear attraction due to repeated positive interactions with the moving potential wall. This α emission was found to take place only through three narrow windows along the barrier ridge but in all possible directions. The motion seems to be nonchaotic and the domain of starting conditions for escaping trajectories is nonlocalized and has irregular boundaries.

37892 (CENBG–89-23) **High resolution measurements of mass, energy and nuclear charge correlations for ^{229}Th (n_{th}, f) with the Cosi Fan Tutte spectrometer.** Boucheneb, N. (Bordeaux-1 Univ., 33 - Gradignan (FR). Centre d'Etudes Nucleaires); Barreau, G.; Doan, T.P.; Leroux, B.; Sicre, A.; Geltenbort, P.; Oed, A.; Boucheneb, N.; Asghar, M.; Goennenwein, F. Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires. 1989. 11p. (CONF-890491–: International conference on fifty years of research in nuclear fission, Berlin (Germany, F.R.), 3-7 Apr 1989). Order Number DE90500785. Available from NTIS (US Sales Only), PC A03/MF A01.

The COSI FAN TUTTE spectrometer has been used to measure for the first time in one go the mass-charge-energy correlations for well-resolved light group masses for ^{229}Th (n_{th},f). About 4.8 x 10^5 events were collected in a ≈ 3 months run. The global mass distribution shows structures and the distribution for E_L = (112±0.5) MeV is dominated by mass numbers A_L = 86 and 96. The mean kinetic energy (E_L) shows strong fluctuations as a function of the light fragment mass A_L. The mean proton odd-even effects in yields and energy are δp = (40.0 ± 1.0)% and δE^{o-e}_{TKE} = (1.35 ± 0.17) MeV. The $\delta p(E_L)$ varies by a factor of ≈ 3 for E_L = 92 to 107 MeV with a plateau for E_L ≈ 96 to 103 MeV. The mean neutron odd-even effect is δn = (1.95 ± 0.5)%. The mean value of the conditional variance is $\langle \sigma^2(Z/A) \rangle$ = (0.33 ± 0.02) and it varies little with energy. The conditional variance seems to decrease as one goes from ^{252}Cf to ^{230}Th. These data are discussed in the context of existing results on other nuclei.

37893 (DOE/ER/40388–50) **Research in theoretical nuclear physics: Progress report.** State Univ. of New York, Stony Brook, NY (USA). Dept. of Physics. Jun 1990. 159p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER40388. Order Number DE90012693. Available from NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.

We shall organize the description of our many activities under following broad headings: Strong Interaction Physics: the physics of hadrons; QCD and the nucleus; and QCD at finite temperature and high density. Relativistic Heavy Ion Physics. Nuclear Structure and Many-body Theory. Nuclear Astrophysics. While these are the main areas of activity of the Stony Brood group, they do not cover all activities.

37894 (ISN–89-42) **Influence of the mass asymmetry of the entrance channel on incomplete fusion processes.** Lleres, A. (Grenoble-1 Univ., 38 (FR). Inst. des Sciences Nucleaires); Nifenecker, H.; Blachot, J.; Gizon, A.; Nifenecker, H.; Blachot, J.; Crancon, J.; Maurel, M.; Ristori, C.; Pienkowsky, L. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. May 1989. 32p. Order Number DE90500786. Available from NTIS (US Sales Only), PC A03/MF A01.

The angular and velocity distributions of incomplete fusion residues have been measured, around 30 AMeV projectile incident energy, for a number of systems with varying mass asymmetries, from the most asymmetric S+Cu, to the almost symmetric Ar+Ca. The main experimental finding is that the parallel width of the velocity distribution increases sharply for decreasing asymmetries, while the perpendicular width remains nearly constant. Using, as data, the widths and mean values of the velocity distributions, it was possible to derive the number of preequilibrium particles emitted by the projectile and by the target. It was found that target emission becomes noticeable only when the center of mass velocity of the target, at nuclear contact, exceeds approximately 2.5 cm/ns. This underlines the relevance of the center of mass velocities in the preequilibrium emission and incomplete fusion processes.

37895 (JINR-E–4-88-930) **Neutral strange particle production in antiproton-nucleus annihilation at low energies.** Kharzeev, D.Eh. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki); Sapozhnikov, M.G. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1988. 7p. Order Number DE90629310. Available from NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS.

Submitted to the Phys. Lett. B.

The cross sections of the Λ- and K_S^0-meson production in antiproton annihilation on nuclei at low energies (E_{pbar}<200 MeV) are calculated under assumption that the sole source of the Λ is rescattering of the annihilation mesons. Besides π^- and K-meson rescattering, Λ production in reactions with π^- and ω-mesons is also considered. It is shown that these processes ensure a significant Λ-production even in the low energy region well below the $\Lambda\Lambda$-bar-threshold. 18 refs.; 1 tab.

37896 (KEK–89-12, pp. 195-200) **A phase shift analysis of proton-proton scattering in P_L = 1.0 - 2.2 GeV/c region and diproton resonances.** Kanada, H. (Niigata Univ. (Japan). Dept. of Physics); Sakai, K. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Sep 1989. (CONF-8810498–: Workshop

on the experiments by polarized proton and electron beams, Tsukuba (Japan), 27-28 Oct 1988). In *Proceedings of the workshop on the experiments by polarized proton and electron beams.* Order Number DE90777829. Available from NTIS (US Sales Only), PC A11/MF A01.

The results of the phase shift analysis of the pp elastic scattering data (P_L = 1.0 - 2.2 GeV/c) is reported. The results for the $^3P_2$, $^1D_2$, $^3F_3$ and $^1G_4$ waves are in agreement with the our previous results. They show the resonance-like behaviours in the Argand diagrams. Especially, it is also shown that the amplitudes for the $^1D_2$ and $^3F_3$ waves show new resonance-like structures. We can not find the solution as given by Saclay-Geneva group which is consist with the low energy solution. (author).

37897 (KEK–89-12, pp. 201-212) **Phase shift analysis of nucleon-nucleon scattering.** Hoshizaki, Norio (Kyoto Univ. (Japan). Dept. of Nuclear Engineering). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Sep 1989. (CONF-8810498–: Workshop on the experiments by polarized proton and electron beams, Tsukuba (Japan), 27-28 Oct 1988). In *Proceedings of the workshop on the experiments by polarized proton and electron beams.* Order Number DE90777829. Available from NTIS (US Sales Only), PC A11/MF A01.

We report our recent works on I. pp phase shift analysis from 1-3.5 GeV/c performed in search for resonances in the mass range 2.1-2.8 GeV, and II. dibaryon signal in NΔ scattering close to NΔ threshold. In I, the known resonances in the $^1D_2$ and $^3F_3$ waves are confirmed by solutions below 2 GeV/c. Above 2 GeV/c, we construct two set of solutions. In set 1, we observe a considerably large anticlockwise looping motion in the Argand diagram for $^1S_0$ state. Simple Breit-Wigner analysis gives M≈2680 MeV, Γ≈125 MeV, $\Gamma_{el}/\Gamma \approx 0.4$. Small structure in the $^1G_4$ wave (M≈2560 MeV) and $^3H_5$ waves (M≈2740 MeV) are mentioned in addition. Solution 2 has a possible structure in the $^3P_2$ wave with M≈2750 MeV. In II, we first argue how the $^1D_2$ resonance found in pp analysis appears in S-wave NΔ scattering near NΔ threshold. By considering the instability of the Δ particle adequately, it is shown that the experimental NΔ phase shift near NΔ threshold reported recently is explained by the 2^+-pole lying on the first sheet of the NΔ cut and just below the branch point of the cut. The case of the pole lying on the second sheet of the NΔ cut is also considered in comparison. We next discuss P-wave NΔ resonance scattering, in relation to the experimental NΔ phase shift. It is shown that if we assume the Breit-Wigner form for coupled-channel scattering for pp, NΔ, etc., the resonance energy in the NΔ channel shifts upward as compared with the one in the pp channel due to the instability of the Δ particle. The 3^--pole as reported in the pp analysis may appear in $^5P_3$-wave NΔ scattering as a structure at an energy considerably higher than the one found in pp elastic scattering. (author).

37898 (KEK–89-13, pp. 57-62) **Polarization of lanthanum nucleus by dynamic polarization method.** Adachi, Toshikazu (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Ishimoto, Shigeru; Masuda, Yasuhiro; Morimoto, Kimio. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1989. (In Japanese). (CONF-8903201–: 2. KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons, Tsukuba (Japan), 11 Mar 1989). In *The 2nd KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons.* Order Number DE90760025. Available from NTIS (US Sales Only), PC A07/MF A01.

Preliminary studies have been carried out concerning the application of a dynamic polarization method to polarizing lanthanum fluoride single crystal to be employed as target in experiments with time reversal invariance. The present report briefly outlines the dynamic polarization method and describes some preliminary studies carried out so far. Dynamic polarization is of particular importance because no techniques are currently available that can produce highly polarized static nucleus. Spin interaction between electrons and protons (nuclei) plays a major role in the dynamic polarization method. In a thermal equilibrium state, electrons are polarized almost completely while most protons are not polarized. Positively polarized proton spin is produced by applying microwave to this system. The most hopeful candidate target material is single crystal of LaF_3 containing neodymium because the crystal is chemically stable and easy to handle. The spin direction is of great importance in experiments with time reversal invariance. The spin of neutrons in the target can be cancelled by adjusting the external magnetic field applied to a frozen polarized target. In a frozen spin state, the polarity decreases slowly with a relaxation time that depends on the external magnetic field and temperature. (N.K.).

37899 (ORNL/FTR–3000) **[Heavy-ion nuclear reactions]: Foreign trip report, June 10, 1988–August 2, 1988.** Gomez del Campo, J. Oak Ridge National Lab., TN (USA). 17 Aug 1988. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012373. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The purpose of the assignment to The Istituto Nazionale di Fisica Nucleare (INFN) in Naples was to continue the collaboration with the heavy-ion nuclear physics group. This collaboration included the analysis of experiments done at the French facilities of SARA and GANIL (discussed in reports FTR-2061 and FTR-2672). While in Naples, the traveler was invited to give a seminar at the Laboratori Nazionali di Legnaro, Padua, and to participate with the group of F. Terrasi (Naples) in an experiment. In addition, the traveler was invited to give a 12-lecture course on the statistical model of nuclear reactions for nuclear physics students of the University of Naples and for staff members of the INFN.

37900 (RCNP-P–107, pp. 6-8) **Polarized ^{3}He beam with intermediate energies: sup 3He elastic scattering and (sup 3He, sup 2He) reaction.** Yahiro, M. (Shimonoseki Univ. of Fisheries, Yamaguchi (Japan)). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

Polarized ^{3}He beam with intermediate energies will be available soon at RCNP. Physics using the beam is discussed. It is well known that the optical potential for ^{3}He elastic scattering at 33 MeV has a strange geometry in its spin-orbit part. The famous problem may be solved with experiments of ^{3}He elastic scattering at the intermediate energies. Recently Yahiro et al. proposed a new method to treat final state interactions in (^{3}He, ^{2}He) reaction. The method based on the adiabatic approximation successfully explains the reaction at 33 MeV. The method is straightforwardly applicable for (d, ^{2}He) reactions at intermediate energies which are important as production reactions of giant resonances and π^-. (author).

37901 (RCNP-P–107, pp. 9-13) **Four nucleon system at intermediate energy.** Fukunaga, K. (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

Breakup reactions for four nucleon systems are discussed in the intermediate energy region. The Faddeev Yakubovski type Sloan's amplitudes can be expanded to a multiple scattering series and compared with the three body scattering AGS amplitudes. Two coincidence measurements for breakup reactions such as d+d→d+p+n and ^{3}He+p→d+p+p are proposed as the experiments in the cascade project of RCNP. (author).

37902 (RCNP-P–107, pp. 14-16) **Production of η meson by p+d→^{3}He+η reaction at the near threshold.** Matsuoka, Nobuyuki (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

Published in summary form only. PROTON REACTIONS/deuterium target; PROTON REACTIONS/eta mesons; POLARIZED BEAMS; MEV RANGE 100-1000; THRESHOLD ENERGY; REACTION KINETICS; HELIUM 3

37903 (RCNP-P–107, pp. 36-44) **Delta isobar in (h,t) reactions.** Toki, H. (Tokyo Metropolitan Univ. (Japan). Dept. of Physics). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

We study the delta isobar problem found in the (h,t) reactions at E=2GeV. We find the nuclear medium effect is not expected large due to the fact that the (h,t) reactions can probe only the low density region at the nuclear surface. Instead, we find that the projectile delta process, hitherto neglected, is responsible in producing a different spectral shape for neutrons from that for protons. The experimental evidence for this prediction is seen in the spectrum for deuterons, which is different from that for protons. This is claimed to be the major source of the delta isobar problem for the case of the nuclear targets. The essential features of other experimental data concerning the delta isobar excitations are also understood by considering this mechanism. (author).

37904 (RCNP-P–107, pp. 100-108) **Trends in atomic mass studies and comparisons of masses, Q-values, etc. of unstable nuclei.** Uno, Masahiro (Ministry of Education, Tokyo (Japan)). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

A brief comment is given on atomic mass studies from '1975 MASS PREDICTIONS' till '1986-1987 MASS PREDICTIONS'. Then, the outline of our recent mass formula is shortly explained in terms of 'mutual support of magicities' and 'cooperative deformation effect'. Finally, several formulas in '1986-1987 MASS PREDICTIONS' are compared with respect to masses, Q-values, etc. of unstable nuclei. (author).

37905 (RCNP-P–107, pp. 114-120) **Light ion reaction.** Terasawa, Tokuo (Tokyo Univ. (Japan). Coll. of General Education). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

The three-body treatment of the final state in (^{3}He, pp) reactions proposed by Yahiro et al is extended to analyze (d, ^{2}He) reactions. A possibility of finding giant quadrupole resonances in excited nuclei is briefly discussed. (author).

37906 (RCNP-P–107, pp. 174-179) **(p,π^-) reactions leading to the high-spin stretched 2p-1h states within the two-nucleon production model.** Kume, Kenji (Nara Women's Univ. (Japan). Dept. of Physics). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

We have studied the (p,π^-) reactions leading to the high-spin stretched 2p-1h states within the two-nucleon production model. It is shown that the two-body process with the final protons coupled to spin singlet state $p+n \rightarrow (p+p)^{S=0}+\pi^-$ dominated the reaction cross section, while the asymmetry is affected appreciably by the transition to spin triplet proton pair $p+n \rightarrow (p+p)^{S=1}+\pi^-$. The main features of the measured angular distributions of the cross section and the asymmetry are explained within the present model. (author).

37907 (RCNP-P–107, pp. 191-198) **Study of the NN interaction through (p, 2p) reactions and construction of focal plane detectors for a spectrograph pair.** Noro, Tetsuo (Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

A proton knockout reaction is a useful tool for the study of the NN interaction in nuclear matter. In this report, prospects of the study through this reaction are presented and the feasibility of the spin measurements using a spectrograph pair is discussed. Some results obtained in our development work for focal plane counters are also reported. (author).

37908 (RCNP-P–108) **Proceedings of the workshop on nuclear structure by gamma spectroscopy.** Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. 178p. (In Japanese). (CONF-8908235–: Workshop on nuclear structure by gamma spectroscopy, Ibaraki (Japan), 31 Aug - 2 sep 1989). Order Number DE90798857. Available from NTIS (US Sales Only), PC A09/MF A01.

This issue is the collection of the papers presented at the title meeting. The 36 of the presented papers are indexed individually. (J.P.N.).

37909 (UCRL-JC–104221) **Models and theory for precompound angular distributions.** Blann, M. (Lawrence Livermore National Lab., CA (USA)); Pohl, B.A.; Remington, B.A.; Scobel, W.; Trabandt, M.; Byrd, R.C.; Foster, C.C.; Bonetti, R.; Chiesa, C.; Grimes, S.M. Lawrence Livermore National Lab., CA (USA). 6 Jun 1990. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48 ;W-7405-ENG-36. (CONF-9006213–1: International Atomic Energy Agency (IAEA)-CRP on fast neutron cross-sections conference, Vienna (Austria), 20-22 Jun 1990). Order Number DE90013475. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We compare angular distributions calculated by folding nucleon-nucleon scattering kernels, using the theory of Feshbach, Kerman and Koonin, and the systematics of Kalbach, with a wide range of data. The data range from (n,xn) at 14 MeV incident energy to (p,xn) at 160 MeV incident energy. The FKK theory works well with one adjustable parameter, the depth of the nucleon-nucleon interaction potential. The systematics work well when normalized to the hybrid model single differential cross section prediction. The nucleon- nucleon scattering approach seems inadequate. 9 refs., 10 figs.

37910 **Relativistic effects in low-energy nucleon-nucleon scattering.** Gross, F. (Continuous Electron Beam Accelerator Facility, 12000 Jefferson Avenue, Newport News, Virginia 23606 (USA)— College of William and Mary, Williamsburg, Virginia 23185 (USA)); Van Orden, J.W.; Holinde, K. *Physical Review, C (Nuclear Physics) (USA),* 41(5): 1909-1912 (May 1990). DOE Contract FG05-88ER40435.

We show that it is possible to obtain a quantitatively excellent description of low energy *NN* scattering, including the deuteron, using a relativistic equation with a simple one boson exchange kernel consisting of the exchange of only π,σ,ρ, and ω mesons. Relativistic properties of the meson-nucleon couplings play an essential role in the success of the description. A second model which includes σ_1 and η mesons in addition to those in the four-meson model has also been constructed and is virtually equivalent to the four-meson model on shell. Since these two models differ off shell and are the same on shell, the low energy on-shell *NN* data cannot completely determine the off-shell *NN* amplitudes.

37911 **Parity-violating asymmetry in $\vec{p}\,p$ scattering at medium energies.** Kloet, W.M. (Department of Physics and Astronomy, Rutgers University, New Brunswick, New Jersey 08903 (USA)); Silbar, R.R.; Tjon, J.A. *Physical Review, C (Nuclear Physics) (USA),* 41(5): 2263-2265 (May 1990).

The longitudinal asymmetry in $\vec{p}\,p$ scattering due to weak exchange of a charged pion is recalculated using a more realistic strong *NN* interaction to evaluate the effect of initial and final state rescattering. The pion-exchange contribution to the asymmetry at medium energy is smooth and equals 0.5×10^{-7} at 800 MeV. This pion contribution has to be added to the conventional rho and omega contribution which, at this energy, has the same sign and

about the same size. The total result, about 1.0×10^{-7}, should be compared to the experimental value at 800 MeV which is $2.4\pm1.1\times10^{-7}$

37912 Theory of the isotensor term in the pion-nucleus optical potential. Koltun, D.S. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627 (USA)); Singham, M.K. *Physical Review, C (Nuclear Physics) (USA),* 41(5): 2266-2276 (May 1990). DOE Contract FG02-88ER40425.

Phenomenological analysis of double charge exchange scattering of pions shows that there is a sizable isotensor term in the optical potential at resonant energies. In an earlier paper we proposed that this term could be expected to reflect coupling of the elastic and analog channels to particular nonelastic channels with specific isospin structure. In this paper we present detailed models for this channel coupling, based on pion absorption and correlated double scattering. It is shown that any of the models could contribute to the isotensor potential with the appropriate phase. New predictions of isospin dependence of the potential are given.

37913 Uncertainties in the two-nucleon potential and nuclear matter predictions. Jiang, M.F. (Department of Physics, University of Idaho, Moscow, Idaho 83843 (USA)); Machleidt, R.; Kuo, T.T.S. *Physical Review, C (Nuclear Physics) (USA),* 41(5): 2346-2352 (May 1990). DOE Contract FG02-88ER40388.

The effects of uncertainties in the two-nucleon potential on the saturation properties of nuclear matter are studied. The nuclear matter energy is calculated by a recently developed ring-diagram method. The largest variations in the energy are due to ambiguities in the (off-shell) strength of the nuclear tensor force. For the six different realistic potential models considered, the total uncertainty is about 3 MeV for the saturation energy and 0.2 fm^{-1} for the saturation Fermi momentum. This variation is substantially smaller than the corresponding one obtained in standard lowest-order Brueckner calculations (6 MeV, 0.3 fm^{-1}). The relevance of the tensor force for ring-diagram contributions is investigated systematically.

37914 Mixed-symmetry states in ^{144}Nd: Semimicroscopic accounting within the cluster vibration model and its mapping into the interacting boson model. Meyer, R.A. (Nuclear Chemistry Division, Lawrence Livermore National Laboratory, Livermore, California 94550 (USA)— Institut fuer Kernphysik II, Kernforschungsanlage Juelich GmbH, 5170Juelich-1, (Federal Republic of Germany)); Scholten, O.; Brant, S. *Physical Review, C (Nuclear Physics) (USA),* 41(5): 2386-2396 (May 1990). DOE Contract W-7405-ENG-48.

We have investigated the structure of $^{144}Nd_{84}$ within the framework of the cluster vibration model. Further, we have mapped, approximately, the cluster vibration model states into the proton-neutron interacting-boson model, with particular emphasis on the mixed-symmetry states, hindered transitions, quadrupole moment signs, and higher-angular-momentum pairs. The cluster vibration model 2^+ (3) state and its properties correspond to the experimentally determined properties and map into the mixed-symmetry state of the proton-neutron interacting-boson model. We compare the calculations with recent in-beam (*t,p*) multiparameter (particle, gamma, gamma/conversion-electron) coincidence studies, which have established the positive-parity spectra up to 3 MeV. Some evidence is given for 0^+ and 1^+ levels associated with the 2^+ (3) mixed-symmetry state.

37915 *Z* dependence of Coulomb dissociation cross sections in heavy ion reactions. Lissauer, D. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973 (US)); Takai, H. *Physical Review, C (Nuclear Physics) (USA),* 41(5): 2410-2413 (May 1990). DOE Contract AC02-76CH00016.

It is demonstrated that the naive expectation of Z_T^2 dependence of the cross section for reactions produced via Coulomb dissociation in heavy ions is modified substantially due to the "apparent" charge distribution. The deviations are shown to be important in predicting both the energy and the Z_T dependence of the cross sections. The effect increases with *Q* value of a given dissociation channel; for a given *Q* value the deviation is larger for lower incident energy.

37916 Exclusive photonuclear reactions and asymptotic scaling. Holt, R.J. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439 (US)). *Physical Review, C (Nuclear Physics) (USA),* 41(5): 2400-2402 (May 1990). DOE Contract W-31-109-ENG-38.

Recent measurements of electron-deuteron elastic scattering at high momentum transfer have placed an empirical lower limit on the momentum transfer for the onset of asymptotic scaling. The implications that this limit has for the $^2H(\gamma,p)n$, $^2H(\gamma,d)\pi^0$, and $^3He(\gamma,d)H$ reactions will be discussed.

37917 Nuclear charge symmetry breaking and quantum-chromodynamically-induced corrections to quantum electrodynamics. Maltman, K. (York University, 4700 Keele Street, North York, Ontario, Canada M3J1P3 (Canada)); Stephenson, G.J. Jr.; Goldman, T. *Physical Review, C (Nuclear Physics) (USA),* 41(6): 2764-2769 (Jun 1990).

Charge-symmetry breaking operators induced by quantum chromodynamical corrections to one-photon-exchange and one-photon loop graphs have been recently shown to contribute to isomultiplet splittings in the hadron spectrum at a level comparable to that of one-photon-exchange operators. We investigate the consequences of the existence of such (color-dependent) operators for charge-symmetry breaking in the ^{3}He-^{3}H and $_\Lambda{}^4$He-$_\Lambda{}^4$H systems and demonstrate that sizable contributions to the charge-symmetry-breaking binding-energy differences are expected, especially in the former system.

37918 Hypertriton: $\Lambda\leftrightarrow\Sigma$ conversion and tensor forces. Afnan, I.R. (School of Physical Sciences, The Flinders University of South Australia, Bedford Park, South Australia 5042, (Australia)); Gibson, B.F. *Physical Review, C (Nuclear Physics) (USA),* 41(6): 2787-2799 (Jun 1990).

The separable potential equations that describe the hypertriton when ΛN-ΣN coupling and noncentral *NN* and *YN* forces are included, are formulated. Numerical solution of the equations for various potential models shows that Λ-Σ conversion in the *YN* interaction plays a significant role, even in the lightly bound $_\Lambda{}^3$H. When the ΣN channel is formally eliminated, the dispersive energy dependence of the resulting ΛN effective interaction is repulsive, whereas the resulting ΛNN three-body force is attractive. The contribution of the ΛN tensor force is shown to depend upon the inclusion of the *NN* tensor force and the relative sign of the $^3S_1$-$^3D_1$ *NN* and ΛN tensor coupling. Also, a model which supports a ΣN bound state in the continuum appears to severely overbind the $_\Lambda{}^3$H system, indicating that such a phenomenon is not present in the $K^-d\rightarrow\Lambda N\pi$ reaction.

37919 Off-shell form factors and low energy theorems for pion photoproduction. Naus, H.W.L. (National Institute for Nuclear Physics and High Energy Physics, Section K (NIKHEF-K), P.O. Box 41882, NL-1009 DB Amsterdam, (The Netherlands)); Koch, J.H.; Friar, J.L. *Physical Review, C (Nuclear Physics) (USA),* 41(6): 2852-2864 (Jun 1990).

The derivation of the low energy theorem for threshold photoproduction of neutral pions on a nucleon is reconsidered. Instead of considering explicitly the Born terms, as done in earlier derivations, a more general class of diagrams is separated from the total amplitude. Gauge invariance is imposed on the operator level and the partial conservation of the axial-vector current constraint is incorporated. Besides recovering the older results in this approach, relations for the off-shell behavior of the strong and electromagnetic vertices are derived.

37920 Nuclear Ramsauer effect and the isovector potential. Anderson, J.D. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550 (US)); Grimes, S.M. *Physical Review, C (Nuclear Physics) (USA),* 41(6): 2904-2910 (Jun 1990). DOE Contract W-7405-ENG-48.

The simple nuclear Ramsauer model is extended to include explicitly the isovector potential. This model predicts large differences between proton and neutron total nuclear cross sections. When this model is applied to isotope/isotone total neutron cross section differences, it gives a good description of the measured data in the mass 140 region. Non-isospin-dependent differences in the isotopic imaginary potential are observed which totally obscure the

contribution from the isovector imaginary potential. Additional measurements further from closed nuclear shells may yield useful information on the isovector imaginary potential.

6540 Radiation and Shielding Physics

Refer also to citation(s) 38119

37921 (CTH-RF–66) **One-speed neutron transport eigenvalues for reflected slabs and spheres.** Garis, N.S. Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Reactor Physics. Mar 1990. 52p. Order Number DE90630887. Available from NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The monoenergetic transport equation with isotropic scattering and vacuum boundary conditions is applied to two-medium spherical and plane systems. The mean-free-path is assumed to be the same even though the multiplication factors are different in both media. The two coupled integral equations that are obtained are numerically solved using Carlvik's method. Tables of seven or more eigenvalues for various dimensions of the bodies are given and the first 5 flux modes for some cases are plotted. In addition, for homogeneous systems we present more accurate and high order c-eigenvalues than those known so far. (author).

37922 (CTH-RF–69) **Study of the multiple scattering effect in TEBENE using the Monte Carlo method.** Singkarat, Somsorn. Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Reactor Physics. Jan 1990. 29p. Order Number DE90630888. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The neutron time-of-flight and energy spectra, from the TEBENE set-up, have been calculated by a computer program using the Monte Carlo method. The neutron multiple scattering within the polyethylene scatterer ring is closely investigated. The results show that multiple scattering has a significant effect on the detected neutron yield. They also indicate that the thickness of the scatterer ring has to be carefully chosen. (author).

37923 (CTH-RF–71) **McSUB, a Monte Carlo Library for neutron transport in two different media for the neutron energy range 0.1-20 MeV.** Hoek, M. Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Reactor Physics. May 1990. 123p. Order Number DE90630889. Available from NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

Library McSUB is a package of easy-to-use subroutines and functions treating neutron transport in two different kind of media by Monte Carlo calculations. The first medium, D0, contains deuterium and natural carbon while the second medium, D1, contains hydrogen and natural carbon. In the neutron energy interval 0.1-20 MeV eight different kinds of interactions are considered: Elastic and (n,2n) interactions with deuterium, elastic interactions with hydrogen and elastic and inelastic interactions with natural carbon. The inelastic interaction with carbon are subdivided into four different interaction classes, one for each excited state of the recoiled carbon nucleus. The neutron cross sections and Legendre coefficients (expressing differential cross sections) have been supplied by NEA Data Bank in France. (author).

37924 (KEK–89-13, pp. 1-10) **Neutron interference experiment and quantum-mechanical observation problem.** Otake, Yoshie (Waseda Univ., Tokyo (Japan). School of Science and Engineering). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1989. (In Japanese). (CONF-8903201–: 2. KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons, Tsukuba (Japan), 11 Mar 1989). In *The 2nd KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons.* Order Number DE90760025. Available from NTIS (US Sales Only), PC A07/MF A01.

A neutron interferometer comprising a perfect silicon crystal is generally used in thermal neutron beam interference experiments. These experiments permit basic quantum-mechanical studies on a macroscopic scale. The report outlines experiments involving spin inversion which is associated with wave packet shrinkage, one of the observation problems. Discussion is made based on a multiple Hilbert space theory. The theory provides a criterion to judge whether wave packet shrinkage is caused by an interaction between microscopic particles and a macroscopic system. The criterion for wave packet shrinkage is expressed in terms of the fluctuation in the macroscopic system and effective wave number which depends on the interaction. Wave packet shrinkage associated with the interaction between an aluminum phase shifter and neutrons is discussed to show that the multiple Hilbert space theory properly describes the interaction of neutrons with a macroscopic system. It is shown that their interaction does not always cause wave packet shrinkage. It is also revealed that if interference fringes due to coherence of neutrons occurs, it does not mean the corpuscular nature and wavy nature are observed simultaneously. (N.K.).

37925 (KEK–89-13, pp. 11-18) **Interference experiment and analysis of neutron wave packet.** Morikawa, Yoshitomi (Waseda Univ., Tokyo (Japan). School of Science and Eigneering). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1989. (In Japanese). (CONF-8903201–: 2. KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons, Tsukuba (Japan), 11 Mar 1989). In *The 2nd KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons.* Order Number DE90760025. Available from NTIS (US Sales Only), PC A07/MF A01.

Various devices are incorporated in an interferometer used for neutron interference experiments. Recently, neutron wave packet has come into used for interference experiments instead of plane wave of neutrons. It is known, however, that when wave packet is used, the fluctuation in its wavelength acts to attenuate the interference term in the intensity equation, affecting the shrinkage of the wave packet. The damping term is generally derived from the intensity associated with a plane incident wave while taking into account Gaussian wave fluctuation. To improve this, a model is set up and used here to analyze the damping effect of wave fluctuation on the interference term in the intensity equation. For an interferometer incorporating Ti as a device, the wavelength fluctuation of the incident particles are studied and Glauber approximation is applied to the scattering of the incident particles by the device. The equation derived is found to be more useful to explain experimental results than those conventionally used. The new technique can also take into account other factors, such as the device's thickness fluctuation, that can have damping effects on the interference term. (N.K.).

37926 (KEK–89-13, pp. 19-24) **Experiment of measuring neutron life.** Kawai, Hideyuki (Chiba Univ. (Japan). Coll. of Arts and Sciences). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1989. (In Japanese). (CONF-8903201–: 2. KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons, Tsukuba (Japan), 11 Mar 1989). In *The 2nd KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons.* Order Number DE90760025. Available from NTIS (US Sales Only), PC A07/MF A01.

The life of neutrons is one of basic nuclear constants in itself, and plays an important role for determining the axial vector coupling constant in the weak interaction. Also it is related to the quantity of primitive He-4 production in the Big Bang cosmic theory and the number of the kinds of neutrinos, further to the solar neutrino problem. The beta decay of neutrons becomes the mixed transition of 'Fermi' and 'Gamow-Teller'. The vector coupling constant is relatively accurately determined from the pure Fermi transition. Accordingly, by measuring the life of neutrons, the axial vector coupling constant is determined. According to the Big Bang cosmic theory, the proportion of He-4 is determined by the life of neutrons and the cooling rate of the cosmos. The possibility of four kinds of neutrinos is little at the current measured value of neutron life. In the measurement of solar neutrino intensity, Davis et al. obtained 2.1 ± 0.3 SNU. The theoretical value is 5.8 ± 2.2 SNU, and the discrepancy is large. The accuracy of the measurement of neutron life is poor. The methods of measuring neutron life and their errors are discussed. The measuring equipment proposed by the authors is explained. (K.I.).

37927 (KEK–89-13, pp. 80-90) **General report on UCN facility experiment.** Utsuro, Masahiko (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1989. (In Japanese).

(CONF-8903201–: 2. KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons, Tsukuba (Japan), 11 Mar 1989). In *The 2nd KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons.* Order Number DE90760025. Available from NTIS (US Sales Only), PC A07/MF A01.

The ultracold neutrons with the energy less than about 1 μeV, or in terms of temperature, about 1/1000 deg K are at superlow velocity and have long wavelength, and do very peculiar behavior. Recently the plan to generate these ultracold neutrons powerfully and utilize them for the research on physical properties and elementary particles has been carried out. The history of ultracold neutrons began about 30 years ago. The method of counting ultracold neutrons is briefly explained. The velocity of ultracold neutrons is very slow and does not exceed about 10 m/s, accordingly also in the time of flight method, several tens cm is enough. They have very low energy, and do total reflection on the surfaces of many substances. In the earth gravity field, they rise just upward, but at 1-2 m, fall again. They have the possibility of being used usefully for the structural analysis of much larger as compared with crystal lattice or molecules and the research on physical properties using the neutron spectrometry of superhigh resolution. The generation of ultracold neutrons, the facilities of ultracold neutron experiment and so on are reported. (K.I.).

37928 (KEK–89-13, pp. 91-106) **Superfluidity helium type UCN converters.** Kawai, Takeshi (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Utsuro, Masahiko; Yoshiki, Hajime; Tanaka, Syo; Yamaguchi, Akira; Morita, Yoshiyuki; Sakai, Kenji. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1989. (In Japanese). (CONF-8903201–: 2. KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons, Tsukuba (Japan), 11 Mar 1989). In *The 2nd KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons.* Order Number DE90760025. Available from NTIS (US Sales Only), PC A07/MF A01.

Ultracold neutrons mean the neutrons with wavelength of several hundreds A which do total reflection even if they are irradiated vertically on a metal surface. By utilizing this property, ultracold neutrons were stored in metallic bottles for the first time by Shapiro. At present, by utilizing such properties that the neutrons in a vessel can be stored for several hundreds sec close to their life of beta decay, and that the potential energy per 1 m in a gravity field is as small as equivalent to 1.02×10^{-7} eV/m, they are going to be used more for the interesting fields such as the measurement of the life of neutrons and electric dipole moment, the experiment on neutron-antineutron vibration, neutron interferometers and surface physical properties. At present, though ultracold neutron sources are operated, in order to measure the electric dipole moment of neutrons with the accuracy of 10^{-27}, at least 100 times as much ultracold neutron flux as those is required. In this report, the Golub's method of generating ultracold neutrons and its restraining condition, the expected structure of the facilities and so on are described. By this technique, the intensity of ultracold neutrons should be increased by three figures theoretically from the present value. (K.I.).

37929 (KEK–89-13, pp. 111-115) **Generation of spallation neutrons.** Kiyanagi, Yoshiaki (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1989. (In Japanese). (CONF-8903201–: 2. KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons, Tsukuba (Japan), 11 Mar 1989). In *The 2nd KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons.* Order Number DE90760025. Available from NTIS (US Sales Only), PC A07/MF A01.

As the spallation neutron source for neutron scattering, the KENS in the National Laboratory for High Energy Physics was put in practical use for the first time in the world. But thereafter, new spallation neutron sources were operated in USA and UK, and in particular the ISIS in UK aims at about 100 times of the intensity of the KENS. Though it did not yet reach the full power, it has already become the most powerful spallation neutron source in the world. Also in Japan, considering the importance of neutron scattering experiment, the construction of a spallation neutron source of the scale exceeding this is planned. In the present status, though the construction of spallation neutron sources precedes, their optimization has not been sufficiently investigated. In this study, the investigation from the standpoint of neutron engineering was carried out on incident proton energy and the material and size of targets. As the material of the targets for spallation neutron sources, it has been well known that uranium is the best, but since it is a nuclear fuel substance, it is feared that the construction and the maintenance management become very difficult. Accordingly, also the other materials than uranium were examined. Tungsten was good. Incident proton energy shall be up to 2 GeV at maximum. As the length of targets, about 30 cm is enough when proton energy is more than 1 GeV, and the radius of 5 cm is optimum. (K.I.).

37930 (KEK–89-13, pp. 116-118) **Shield for UTS.** Ban, Hidekazu (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1989. (In Japanese). (CONF-8903201–: 2. KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons, Tsukuba (Japan), 11 Mar 1989). In *The 2nd KEK symposium on ultracold neutrons (UCN) and fundamental physics with slow neutrons.* Order Number DE90760025. Available from NTIS (US Sales Only), PC A07/MF A01.

KENS-I' at the National Lab. for High Energy Physics provides a good model in designing the shield for UTS. In KENS-I', an uranium target is placed in a radiation shield made of steel and heavy concrete. The proton energy is 500 MeV and the maximum beam intensity is 10 μA (6×10^{13} ps^{-1}). The laboratory is designed so that the dose equivalent under the above conditions is below the limit of 20 μSv/h (2 mrem/h) for the general management areas in the Lab.. However, the dose equivalent limit for the public areas have been lowered to 1/5 that required at the time of the designing of KENS-I'. Accordingly, the limit for the general management areas in the Lab. has been reduced to 0.2 μSv/h (average over three months). To permit the use of beams with the maximum intensity of 10 μA, improvements are required to reduce the contributions of skyshine, etc., to the surrounding areas. Another important fact is that the proportion of slow-damping components (high-energy neutrons) increases as the shield becomes thicker. Thus, a required damping distance determined from experiments with a thin shield could be too small. Investigations show that the management areas should be largely expanded. (N.K.).

37931 (ORNL/FTR–3057) **[International conference on radiation shielding]: Foreign trip report, September 11–16, 1988.** Rhoades, W.A. Oak Ridge National Lab., TN (USA). 30 Sep 1988. 7p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. Order Number DE90012362. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler presented two papers illustrating practical application of three-dimensional S_n calculations. A good update on the status and trends in Anglo-European-Japanese software was also obtained. There is still an opportunity for DOE to generate future good will by supporting distribution of our recent developments.

37932 (ORNL/TM–11532) **Investigation of radiation effects in Hiroshima and Nagasaki using a general Monte Carlo-discrete ordinates coupling scheme.** Cramer, S.N.; Slater, C.O. Oak Ridge National Lab., TN (USA). May 1990. 24p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. Order Number DE90011280. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A general Monte Carlo-discrete ordinates radiation transport coupling procedure has been created to study effects of the radiation environment in Hiroshima and Nagasaki due to the bombing of these two cities. The forward two-dimensional free-field air-over-ground flux is coupled with an adjoint Monte Carlo calculation. The size, orientation, or translation of the Monte Carlo geometry is unrestricted. The radiation effects calculated are the dose in the interior of a large concrete building in Nagasaki and the activation production of Co-60 and P-32 in Hiroshima. 20 refs., 6 figs., 1 tab.

37933 **Regular and chaotic motion of classical electrons in the wake potential of fast ions in solids.** Mueller, J. (Department of Physics, University of Tennessee, Knoxville, Tennessee 37996-1200 (USA)); Burgdoerfer, J. *Physical Review, A (General Physics)*

(USA), 41(9): 4903-4912 (1 May 1990). DOE Contract AC05-84OR21400.

The classical dynamics of an electron under the influence of a screened Coulomb potential around fast ions in solids is investigated. A transition from regular to chaotic motion as a function of the binding energy is observed. We discuss possible signatures of chaotic dynamics in the final-state distribution of foil-excited atoms.

37934 Alternative forms of the Spencer-Fano equation. Inokuti, M. (Argonne National Laboratory, Argonne, Illinois 60439 (US)); Kowari, K. *Physical Review, A (General Physics) (USA)*, 41(10): 5464-5467 (15 May 1990).

We point out a relation between the electron degradation spectra determined by two differing cross-section sets but subject to the same source. The relation takes a form of the Fredholm integral equation of the second kind and may be viewed as an alternative form of the Spencer-Fano equation. The relation leads to a precise definition of the partial degradation spectra of electrons of successive generations. It also provides a basis for the perturbation theory by which one calculates effects of small changes of cross-section data upon the electron degradation spectrum.

37935 Methods of calculating the Barkas-effect correction to Bethe–Bloch stopping power. Porter, L.E. (University of Montana, Missoula, Montana 59812 (USA)); Lin, H. *Journal of Applied Physics (USA)*, 67(11): 6613-6620 (1 Jun 1990).

The low-velocity Barkas-effect correction term for the Bethe–Bloch stopping-power formula has been calculated with each of the three extant formalisms for targets with atomic numbers from 1 to 18 and for projectile velocities from 0.025*c* to 0.3*c*. Comparison of each with measurements on aluminum revealed which formalism provided the best fit over three different projectile velocity intervals. The method yielding the generally superior agreement was used to calculate the stopping power of each element (except Li, F, Na, Mg, P, and Cl) for protons and alpha particles with energies between 0.5 and 5.0 MeV. Results corresponded very closely to those of an existing fit to most known experimental data.

6550 Medical Physics

Refer also to citation(s) 37932

37936 (AECS-SDB–10) **Radiation protection glossary.** Othman, Ibrahim (Atomic Energy Commission, Damascus (Syria)); Abdul-Rahim, Maha. Atomic Energy Commission, Damascus (Syria). Dec 1989. 49p. (In Arabic). Order Number DE90631313. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

This glossary contains the arabic equivalent of all the terms included in the IAEA Safety Series No.76 (which is a selected basic terms used in IAEA publications), thus this glossary contains English, French, Spanish, Russian, and Arabic. It is intended to facilitate the work of arabic speaking scientists involved in the field of radiation protection.

37937 (IAEA-TECDOC–548) **Handling, conditioning and disposal of spent sealed sources: Technical manual for the management of low and intermediate level wastes generated at small nuclear research centres and by radioisotope users in medicine, research and industry.** International Atomic Energy Agency, Vienna (Austria). Feb 1990. 39p. Order Number DE90631314. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The series entitled "Technical Manual for the Management of Low and Intermediate Level Wastes Generated at Small Nuclear Research Centres and by Radioisotope Users in Medicine, Research and Industry" will serve as reference material to experts on technical assistance missions and provide "direct know-how" for technical staff in developing countries. This document is the first in the series. It provides the technical guidance and know-how necessary to permit developing Member States to safely handle, condition and store spent sealed radiation sources. It covers: characterization of sealed sources, legislation and regulations, management of spent sealed sources, transportation and disposal of spent sealed sources. 5 refs, 10 figs, 6 tabs.

37938 (ICRU–45) **Clinical neutron dosimetry: Part 1, Determination of absorbed dose in a patient treated by external beams of fast neutrons.** International Commission on Radiation Units and Measurements, Bethesda, MD (USA). ©15 Nov 1989. 90p. Sponsored by International Commission on Radiation Units and Measurements, Bethesda, MD. Available from ICRU Publications, 7910 Woodmont Avenue, Suite 800, Bethesda, MD 20814.

The present report is concerned primarily with the determination of absorbed dose in a patient irradiated by beams of fast neutrons. In order to compare the clinical results of fast neutron therapy at different institutions, particularly in clinical trials organized by cooperative groups, it is essential to check and to compare the technical irradiation conditions. Most neutron radiotherapy centers used that report as the main source of information on methodology and basic physical data for neutron dosimetry. However, a number of international neutron dosimetry intercomparisons (e.g., Broerse et al., 1978; ICRU, 1978a) concluded that to reduce differences in quoted absorbed-dose values, it would be necessary to standardize the experimental techniques and that common numerical values of the basic physical parameters should be agreed upon. One of the purpose of this report is to give new recommendations with respect to the values of the basic parameters and experimental techniques employed, based on information now available. 300 refs., 43 figs., 13 tabs.

37939 (NAC-AR–88-01, pp. 147-148) **Standardization of radioactivity.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988*. Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

A solution of ^{201}Tl was standardized and a sample was sent to the Bureau International des Poids et Mesures for comparative measurement. This indicated that the actual activity was about 7% lower than specified and the result was withdrawn from the registration tables. Trial measurements on ^{125}I were conducted in preparation for an international comparison of activity measurements of this radioisotope. ^{139}Ce, ^{109}Cd and ^{137}Cs sources were prepared for a number of users of radioisotopes. A new method for determining the activity of ^{55}Fe was investigated. A Monte Carlo program was written to calculate the interaction probability of photons in the detection systems used. 3 refs.

37940 (SAAS-Mitt–89-13) **Recommendations for the design, manufacture and construction of ventilation systems in nuclear power plants with pressurized water reactors.** Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic). 1989. 16p. (In German). Order Number DE90629996. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

To guarantee radiation protection and nuclear safety, ventilation systems in nuclear power plants during normal operation and during operational states deviating from the normal have important functions to fulfill. Based on a standard drafted by CMEA member states, technical principles were worked out and agreed. These principles may be defined as binding by the National Board for Atomic Safety and Radiation Protection in the licensing procedure in accordance with article 4 of the Ordinance on the Implementation of Atomic Safety and Radiation Protection dated 11 October 1984.

6560 Condensed Matter Physics

Refer also to citation(s) 36839, 37186, 37187, 37191, 37206, 37209, 37220, 37253, 37257, 37538, 37539, 37716, 37736, 37986, 37987, 38272

37941 (CONF-900877–1) **High-resolution Z-contrast imaging in the stem.** Pennycook, S.J.; Jesson, D.E.; Chisholm, M.F. Oak Ridge National Lab., TN (USA). Mar 1990. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 12. international congress for electron microscopy; Seattle, WA (USA); 12-18 Aug 1990. Order Number DE90008892. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Short communication. SUPERCONDUCTORS/scanning electron microscopy; SEMICONDUCTOR MATERIALS/scanning electron microscopy; SUPERCONDUCTORS; DIFFRACTION; IMAGE PROCESSING

37942 (CONF-8909210–) **The 12th Werner Brandt international conference on the penetration of charged particles in matter.** Oak Ridge National Lab., TN (USA). Apr 1990. 680p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. Order Number DE90012031. Available from NTIS, PC A99/MF A01; OSTI; INIS; GPO Dep.

This report contains 51 papers from the international conference on the penetration of charged particles in matter. These papers have been cataloged separately. (LSP)

37943 (CONF-9006216–1) **Semiclassical eigenenergies in the wake of fast ions in solids.** Mueller, J. (Tennessee Univ., Knoxville, TN (USA). Dept. of Physics); Burgdoerfer, J.; Noid, D.W. Oak Ridge National Lab., TN (USA). [1990]. 12p. Sponsored by U.S. DOE Energy Research; National Science Foundation. DOE Contract AC05-84OR21400. From Miniworkshop on quantum chaos; Treiste (Italy); 4 Jun - 6 jul 1990. Order Number DE90012292. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We compare the semiclassical and quantum mechanical eigenenergies of an electron in the wake of a fast, highly charged ion traversing a solid. The classical dynamics of this system shows a transition from regular to chaotic motion as a function of the binding energy. The transition can also be seen in the quantal spectra. We find evidence for a connection between bifurcation of tori and disorder in the energy level sequences. 21 refs., 4 figs.

37944 (KEK–89-8) **Plans for production of undulator X-rays on AR and its applications to material and biological sciences.** Ando, M.; Kikuta, S. (eds.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Sep 1989. 128p. (In Japanese). Order Number DE90798895. Available from NTIS (US Sales Only), PC A07/MF A01.

This report carries 19 studies. The first two describe 'Hope for Andulator X-Rays' and 'A Plan for Application of AR Synchrotron Radiation Beam'. Three studies on undulator X-rays are presented, which are entitled 'Development of X-Ray Undulator', 'AR-BL-NE Triple Beamline' and 'Fluctuations of Synchrotron Radiation Beam Position and Development of a Beam Position Feedback System for a Beamline of the TRISTAN Accumulation Ring'. Two studies on application to Moessbauer X-rays are contained, which are entitled 'Nuclear Resonant Scattering of Synchrotron Radiation X-Rays' and 'Biological Action of Moessbauer Effect – Feasibility of Application to Treatment of Cancer'. Two studies on application to research on surface and interface are addressed, which are entitled 'Application to Research on Surface and Interface; Research by Diffraction' and 'How Can Compton Scattering Serve for Study on Surface Layer?'. Five studies on the application to research on submicron crystal structure' are presented, which are entitled Application to Research on Submicron Crystal Structure; Inorganic and Mineral Substances', 'Comments on Application to Research on Submicron Crystal Structure', etc. The report also contains two studies on abnormal scattering and three studies on microbeam X-rays. (N.K.).

37945 (KEK–89-19) **Proceedings of the second workshop of Japan-UK collaboration on neutron scattering research.** Watanabe, N.; Arai, M.; Ikeda, S. (eds.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1989. 133p. (CONF-8911202–: 2. workshop of Japan-UK collaboration on neutron scattering research, Tsukuba (Japan), 1 Nov 1989). Order Number DE90798861. Available from NTIS (US Sales Only), PC A07/MF A01.

This issue is the collection of the papers presented at the title meeting. The 7 of the presented papers are indexed individually. (J.P.N.).

37946 (NAC-AR–88-01, pp. 214-229) **Solid state and materials research: Solid state interactions in thin-film structures.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

With the decrease in device dimensions, it has become essential to obtain a basic understanding of the solid state interactions which take place in thin-film semiconductor structures during the different heat processing steps. Characterization is carried out mainly by Rutherford backscattering spectrometry and channelling, using accelerated nuclear particles from the Van de Graaff accelerator, while radioactive isotopes provide information about interaction mechanisms. Electron microscopy is used to determine the microstructure of the materials being studied. Although most of the research is related to silicon device technology, attention is also being given to the use of silicides for the metallization of GaAs devices. 8 figs., 8 refs.

37947 (NAC-AR–88-01, pp. 230-243) **Solid state and materials research: Laser irradiation of solids.** National Accelerator Centre, Faure (South Africa). 1988. In *Annual report June 1988.* Order Number DE90630179. Available from NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS.

Surface and sub-surface regions of solids are modified by rapid melting and quenching, using a high-powered, pulsed (30 ns) ruby laser. The main emphasis of this work is on laser annealing, epitaxy and doping of silicon. Computer programs have been developed to calculate the heat-flow which takes place during pulsed laser irradiation. From such calculations, information can be obtained about temperature profiles, melt depths, recrystallization velocities and quench rates. 13 figs., 9 refs., 1 tab.

37948 (NAC-AR–89-01, pp. 117-124) **Solid state and materials research: Solid state interaction in thin-film semiconductor structures.** National Accelerator Centre, Faure (South Africa). 1989. In *Annual report June 1989.* Available from the National Accelerator Centre, PO Box 72, Faure, 7131, South Africa.

Within about 10 years, microelectronic devices will be made with more than a billion (10^9) electronic components per chip. To implement such a sophisticated technology it will be essential to have a fundamental understanding of the solid state interaction between the different materials in thin film semiconductor structures. This is the main purpose of this research program. Characterization and analysis is carried out mainly by Rutherford backscattering spectrometry and channelling using accelerated nuclear particles from the Van de Graaff accelerator, while radioactive isotopes provide information about interaction mechanisms. 6 figs., 1 ref.

37949 (NAC-AR–89-01, pp. 125-136) **Solid state and materials research: Laser irradiation of solids.** National Accelerator Centre, Faure (South Africa). 1989. In *Annual report June 1989.* Available from the National Accelerator Centre, PO Box 72, Faure, 7131, South Africa.

Surface and sub-surface regions of solids are modified by rapid melting and quenching, using a high powered, pulsed (30 ns) ruby laser. The main emphasis of this work is on laser annealing, epitaxy and doping of silicon. Computer programs have been developed to calculate the heat-flow which takes place during pulsed laser irradiation. From such calculations, information can be obtained about temperature profiles, melt-depths, recrystallization velocities and quench rates. 12 figs., 7 refs.

37950 (ORNL/FTR–3147) **[Symposium on dynamic particle-condensed matter interactions]: Foreign trip report, November 28, 1988–December 9, 1988.** Crawford, O.H. Oak Ridge National Lab., TN (USA). 19 Dec 1988. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012252. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler visited the College of Arts and Sciences, University of Tokyo, where he worked on collaborative research with Professors Y. Yamazaki and K. Komaki. He attended a two-day symposium on dynamic particle-condensed matter interactions at nearby Hakone and presented a paper on stopping power of crystals. He visited the Institute of Scientific and Industrial Research at Osaka University, where he conferred with Professors F. Fujimoto and R. Shimizu on research problems of mutual interest. Work was done with Professors Yamazaki and Komaki that could be quite beneficial to DOE programs of the traveler's group at Oak Ridge National Laboratory (ORNL). Also, from discussions at all three locations, information in areas directly relevant to DOE programs at ORNL was obtained.

37951 (RCNP-P–107, pp. 67-71) **Channeling at higher energy.** Ogawa, Hidemi (Nara Women's Univ. (Japan). Dept. of Physics). Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Nov 1989. (In Japanese). (CONF-8903211–: Workshop on cyclotron cascade project, Ibaraki (Japan), 13-15 Mar 1989). In *Proceedings of the workshop on 'cyclotron cascade project'.* Order Number DE90777870. Available from NTIS (US Sales Only), PC A11/MF A01.

Channeling is one of the most interesting phenomena in atomic collision in solids. Here, channeling radiation and resonant coherent excitation are reported. They are caused by the periodicity of the potential which channeled ions feel and expected to become observable using the new facility at RCNP. (author).

37952 (RISO-R–574) **Physics Department. Annual progress report 1 January - 31 December 1989.** Als-Nielsen, J.; Skov Pedersen, J.; Juul Rasmussen, J.; Lebech, B. (eds.). Risoe National Lab., Roskilde (Denmark). Physics Dept. Feb 1990. 124p. Order Number DE90630673. Available from NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS.

Research in the Physics Department covers two main fields: condensed matter physics and plasma physics. The principal activites in these fields are presented in this Progress Report covering the period from 1 January to 31 December 1989. The condensed matter physics research is predominantly experimental utilising diffraction of neutrons and x-rays. The research topics range from studies of two- and three-dimensional structures, magnetic ordering, heavy fermions, phase transitions in model systems to studies of texture and recrystallization kinetics with a more applied nature. The discovery of the high Tc superconductors in 1986 has opened an important new research area, where neutron and x-ray diffraction are used to elucidate the basic mechanism responsible for the superconductivity and in the analysis of the solid state syntheses used in producing the materials. The plasma physics research is partly experimental and partly theoretical. The plasma physics programme is also of a wide scope ranging from fundamental studies of wave propagation, instabilities, solitons and turbulence in plasmas to refuelling a fusion reactor by deuterium-tritium pellets. (author) 4 tabs., 66 ills., 71 refs.

37953 (SAND–90-0632C) **Application of parallel computing to the Monte Carlo simulation of electron scattering in solids: A rapid method for profile deconvolution.** Romig, A.D. Jr. (Sandia National Labs., Albuquerque, NM (USA)); Plimpton, S.J.; Myklebust, R.L.; Newbury, D.E. Sandia National Labs., Albuquerque, NM (USA). [1990]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. (CONF-900877–2: 12. international congress for electron microscopy, Seattle, WA (USA), 12-18 Aug 1990). Order Number DE90009322. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

X-ray microanalysis by analytical electron microscopy (AEM) has proven to be a powerful tool for characterizing the spatial distribution of solute elements in materials. True compositional variations over spatial scales smaller than the actual resolution for microanalysis can be determined if the measured composition profile is deconvoluted. Explicit deconvolutions of such data, via conventional techniques such as Fourier transforms, are not possible due to statistical noise in AEM microanalytical data. Hence, the method of choice is to accomplish the deconvolution via iterative convolutions. In this method, a function describing the assumed true composition profile, calculated by physically permissible thermodynamic and kinetic modeling is convoluted with the x-ray generation function and the result compared to the measured composition profile. If the measured and calculated profiles agree within experimental error, it is assumed that the true compositional profile has been determined. If the measured and calculated composition profiles are in disagreement, the assumptions in the physical model are adjusted and the convolution process repeated. To employ this procedure it is necessary to calculate the x-ray generation function explicitly. While a variety of procedures are available for calculating this function, the most accurate procedure is to use Monte Carlo modeling of electron scattering. 9 refs., 1 fig.

37954 (UCRL–102094) **Stimulated Raman scattering in optical fibers: Polychromatic single-field numerical experiments.** Hawkins, R.J. (Lawrence Livermore National Lab., CA (USA)); Stolen, R.H. Lawrence Livermore National Lab., CA (USA). 29 Nov 1989. 5p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-900328–2: IEEE/LEOS/OSA topical meeting on integrated photonics research, Hilton Head Island, SC (USA), 26-28 Mar 1990). Order Number DE90012894. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We show that the response-function based computational approach to Raman scattering predicts accurately many of the propagation properties of picosecond pulses in single-mode optical fibers. 3 refs., 2 figs.

37955 (UCRL-JC–103247) **Equal eigenvalues in multicomponent diffusion: The extraction of diffusion coefficients from experimental data in ternary systems.** Miller, D.G. Lawrence Livermore National Lab., CA (USA). 2 May 1990. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-9008106–1: 29. annual conference of metallurgists, Ontario (Canada), 26-30 Aug 1990). Order Number DE90012074. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

There has been considerable theoretical and experimental work on ternary systems whose diffusion coefficient matrix has two distinct eigenvalues. This is the most common case. However, with the increasing number of ternary diffusion measurements in liquids, cases have arisen where the eigenvalues may be equal and where the usual equations do not apply. Little work has been done on the solution of the equal eigenvalues case, and none has been done on the connection of this solution to experimental data. This paper will present new explicit expressions connecting ternary diffusion coefficients to experimental data for the precise Gouy and Rayleigh optical methods. Some new results for the two 4-component cases will also be presented. 14 refs.

37956 (UUIP–1186) **A TDC-PC based DPAC spectrometer.** Mayer, A.; Lindgren, B. Uppsala Univ. (Sweden). Inst. of Physics. Sep 1988. 77p. Order Number DE90630674. Available from NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS.

In spectroscopies like muon spin rotation or the time differential perturbed angular correlation method the experimentally determined quantity is a time interval between two events. The transformation of this time into a physically handy signal has in most cases been performed by a time-to-amplitude converter (TAC). The resulting voltage has been digitized in a separate analog-to-digital converter (ADC) and entered some type of multichannel analyser (MCA). Apart from not being very convenient the systems have some significant weaknesses: The available size of the total spectrum area is limited due to the MCA. Nonlinearities in TACs and ADCs and noise in the analog part are well known complications. There is no way to see the experimental result, besides the raw data, during the course of the experiment. Here a new type of data collecting system is described. The basic idea, is to substitute the TAC and EDC for a time-to-digital converter (TDC), that is coupled to a personal computer (PC). The computer, used here, is with 256 kbyte of memory, which is sufficient for both the data collection and for the TDC controlling and data treating program DEPACK. The spectrum area is variable, with a predefined standard size of 8 * 2048 channels. On-line data treatment can be performed with the DEPACK program. With the choice of a TDC all problems related to analog parts in the equipment can be circumvented. The TDC can measure both positive and negative times, which enables in a standard 4 detector setup, the simultaneous collection of 8 spectra. If not objected for other reasons, all fast circuit start and stop signals may access the TDC. Since the maximum conversion frequency of the module is 1 MHz an overload protection is not required.

37957 **Flashlamp-pumped dye and excimer laser planarization of thin metal films.** Marella, P.F. (Stanford Solid-State Electonics Lab., Stanford Univ., Stanford, CA (US)); Pease, R.F.; Tuckerman, D.B. pp. 569-578 of Laser and particle beam chemical processes on surface. Johnson, A.W.; Loper, G.L.; Sigmon, T.W. Materials Research Society, Pittsburgh, PA (USA) (1989).

The fundamental differences between excimer ($\approx$ 30 ns pulse duration) and flashlamp-pumped dye ($\approx$ 500 ms pulse duration) laser planarization are examined for 1.5-2 μm thick gold films over SiO_2 layers. Test structures containing bar patterns (square waves) of 5000 Å peak-to-trough amplitude with spatial periods ranging from 10 μm to 100 μm were prepared and laser-irradiated. A linear

model is presented which describes the time-evolution of the film's surface topography when melted with a dye laser pulse. Excimer laser planarization is found to be susceptible to evaporative recoil effects which may cause undesired pattern amplification.

37958 Process margins for laser planarization of 1 to 5 μm gold films. Bernhardt, A.F. (Lawrence Livermore National Lab., Livermore, CA (US)); Contolini, R.J.; Tuckerman, D.B.; Weisberg, A.H. pp. 559-568 of Laser and particle beam chemical processes on surface. Johnson, A.W.; Loper, G.L.; Sigmon, T.W. Materials Research Society, Pittsburgh, PA (USA) (1989).

A pulsed excimer laser or flashlamp-pumped dye laser is used to melt 1 to 5 μm Au layers. The size of feature which can be filled by laser planarization is limited because of the finite melt duration, but the basic goal of leveling local surface topography is accomplished.

37959 Electron-beam assisted CVD of silicon homoepitaxial films. West, J.P. (Dept. of Electrical Engineering and Computer Engineering, Univ. of New Mexico, Albuquerque, NM (US)); Fleddermann, C.B. pp. 527-532 of Laser and particle beam chemical processes on surface. Johnson, A.W.; Loper, G.L.; Sigmon, T.W. Materials Research Society, Pittsburgh, PA (USA) (1989). DOE Contract AC04-76DP00789.

The use of a wide-area electron beam to aid the deposition of epitaxial silicon films has been studies. The electron beam used in this study is generated using a cold cathode, abnormal-glow discharge which allows a wide variation of electron energy and beam current. Depositions are performed on single crystal silicon substrates which are prepared using standard wet chemical silicon cleaning techniques and an in situ plasma etch using nitrogen trifluoride diluted in hydrogen. The beam diameter is approximately 10 cm and can readily be scaled up to accommodate larger diameters, allowing great potential for large area single wafer deposition. Using electron beams generated in this system, the authors have demonstrated enhanced growth rates and improved crystalline quality for films grown with electron-beam enhancement.

37960 X-ray lithography studies of polysilane using a laser plasma x-ray source. Kubiak, G.D. (Sandia National Labs., Livermore, CA (US)); Outka, D.A.; Zeigler, J.M. pp. 615-620 of Laser and particle beam chemical processes on surface. Johnson, A.W.; Loper, G.L.; Sigmon, T.W. Materials Research Society, Pittsburgh, PA (USA) (1989).

A laser-generated plasma source of monochromatized soft x-rays has been used to study the x-ray lithographic resist properties of poly(cyclohexylmethysilane-co-dimethylsilane). X-ray absorption spectra near the Si $L_{2,3}$ edge of unexposed samples were measured to guide the choice of exposure photon energy. The authors find that poly(cyclohexyl-methylsilane-co-dimethylsilane) exhibits positive tone at x-ray energies near 105 eV (Si 2p resonance), a sensitivity of 1000 mJ/cm^2 and a contract of 1.5. Sensitivity is found to increase markedly when exposed samples are held in air before development. Using simple wire mesh masks, estimates of the minimum achievable linewidth have been made.

37961 Geometric phase in the classical continuous antiferromagnetic Heisenberg spin chain. Balakrishnan, R. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, NM (USA)); Bishop, A.R.; Dandoloff, R. *Physical Review Letters (USA)*, 64(18): 2107-2110 (30 Apr 1990).

We show that the time evolution of a space curve is associated with a geometric phase. This phase arises from the path dependence of the rotation of the natural Frenet-Serret triad with respect to a nonrotating (Fermi-Walker) frame. We derive a general expression in 1+1 dimension for the phase and the associated gauge potential, and discuss the application of this formalism to the classical, continuous, antiferromagnetic Heisenberg spin chain.

37962 Electrodynamical properties of gapless edge excitations in the fractional quantum Hall states. Wen, X.G. (School of Natural Science, Institute for Advanced Study, Princeton, New Jersey 08540 (USA)). *Physical Review Letters (USA)*, 64(18): 2206-2209 (30 Apr 1990). DOE Contract AC02-76ER02220.

The electrodynamical properties of the edge excitations in the fractional quantum Hall (FQH) states are studied. We show how to experimentally measure the (optical) charges of the edge excitations. The interactions between the edge excitations are studied. We also discuss in detail the edge excitations of the $\nu=1\pm1/n$ FQH states. Measuring the dynamical properties of the edge excitations is a practical way to probe the topological orders in the FQH states.

37963 Slow wave propagation in air-filled porous materials and natural rocks. Nagy, P.B. (The Ohio State University, Columbus, Ohio 43210 (USA)); Adler, L.; Bonner, B.P. *Applied Physics Letters (USA)*, 56(25): 2504-2506 (18 Jun 1990). DOE Contract FG02-87ER13749.

Slow compressional waves in fluid-saturated porous solids offer a unique acoustical means to study certain material properties, such as tortuosity and permeability. We present a novel experimental technique based on the transmission of airborne ultrasound through air-filled porous samples. The suggested method can be used to measure the velocity and attenuation of the slow compressional wave in a wide frequency range from 30 to 500 kHz. More important, the technique is so sensitive that it provides irrefutable evidence of slow wave propagation in air-saturated natural rocks and lends itself quite easily to tortuosity measurements in such materials, too.

37964 Observation of a phase transition in the sedimentation velocity of hard spheres. Paulin, S.E. (Department of Physics, Oklahoma State University, Stillwater, Oklahoma 74078 (US)); Ackerson, B.J. *Physical Review Letters (USA)*, 64(22): 2663-2666 (28 May 1990). DOE Contract FG05-88ER45349.

Reduced sedimentation velocities are reported for suspensions of nearly hard PMMA (polymethylmethacrylate) spheres as a function of volume fraction. The absolute sedimentation velocities are sufficiently slow compared to crystal-growth rates so that phase separation is achieved during the sedimentation process. As a result the analytic behavior of the measured sedimentation velocity changes as a function of volume fraction at the freezing and melting points. This transition serves as a definitive marker for comparison with theoretical predictions of sedimentation velocities for hard-sphere liquids and crystals.

37965 Fermi liquid character in the photoemission/inverse photoemission spectra of highly correlated electron systems. Riseborough, P.S. (Department of Physics, Polytechnic University, 333 Jay Street, Brooklyn, New York 11201 (USA)). *Journal of Applied Physics (USA)*, 67(9): 5192-5193 (1 May 1990). DOE Contract FG02-84ER45127.

We calculate the photoemission/inverse photoemission spectrum for an N-fold degenerate Hubbard model, in the $1/N$ approximation. The spectra are broadened, and for sufficiently large Coulomb interaction strengths the spectra show satellites both in the photoemission and the brehmstrahlung isochromat spectroscopy portions of the spectra. The intensity of the spectra at the fermi level are equal to the noninteracting values, in accordance with Luttinger's theorem. We show that this can result in a temperature-dependent peak at the Fermi level; the width of the peak is governed by the quasi-particle lifetime. We relate the temperature dependent peak to the Fermi-liquid properties.

37966 Fast sound in binary fluid mixtures. Campa, A. (The Rockefeller University, 1230 York Avenue, New York, New York 10021 (USA)); Cohen, E.G.D. *Physical Review, A (General Physics) (USA)*, 41(10): 5451-5463 (15 May 1990). DOE Contract FG02-88ER13847.

The calculations and the results that predicted a fast-sound mode in low- as well as high-density binary fluid mixtures are presented in detail. Kinetic theory was used, which allowed a detailed discussion of the microscopic dynamics of the fluid in terms of eigenmodes. The Bhatnagar-Gross-Krook approximation method extended to binary mixtures was employed to solve the appropriate kinetic equation and to obtain approximate eigenmodes of the mixture. The fast-sound mode appears far beyond the hydrodynamic regime as either an extension to higher wave numbers of the hydrodynamic sound eigenmode or as a kinetic eigenmode. Some recent and possible future experiments are discussed.

37967 Rate equation and scaling for fragmentation with mass loss. Edwards, B.F. (Department of Physics, West Virginia University, Morgantown, West Virginia 26506 (US)); Cai, M.; Han, H. *Physical Review, A (General Physics) (USA),* 41(10): 5755-5757 (15 May 1990). DOE Contract FG22-89PC89791.

A linear rate equation describes fragmentation with continuous and discrete mass loss typified by consumption of porous reactive solids and two-phase heterogeneous solids. For a mass-dependent fragmentation rate x^{α} and a continuous-mass-loss rate ϵx^{γ}, $\sigma=\gamma-\alpha-1<0$ yields a "recession regime" where small particles lose mass continuously without breaking, $\sigma>0$ yields a "fragmentation regime" where all particles break, and $\sigma=0$ yields scaling for $\alpha>0$. Shattering for $\alpha<0$ and $\sigma\geq 0$ is runaway fragmentation producing an infinte number of particles in a finite time, Exact and asymptotic solutions, exponent relations, and connections with static percolation are found.

37968 Bounds on the effective properties of polydispersed suspensions of spheres: An evaluation of two relevant morphological parameters. Thovert, J.F. (Laboratoire d'Aerothermique du C. N. R. S., 4 ter, route des Gardes, 92190 Meudon, (France)); Kim, I.C.; Torquato, S.; Acrivos, A. *Journal of Applied Physics (USA),* 67(10): 6088-6098 (15 May 1990). DOE Contract FG05-86ER13482.

Expressions for the two microstructural parameters that appear in the variational third-order bounds [G. W. Milton, Phys. Rev. Lett. **46**, 542 (1981)] for the effective conductivity and elastic moduli of composite media are derived analytically to first order in the sphere concentration c for random well-mixed dispersions of impenetrable spheres with an arbitrary size distribution. These relations lead to rigorous bounds on the effective properties which are exactly valid to order c^2 for such models. The apparent *linear* behavior of the microstructural parameters up to moderately high c enables one to apply the bounds beyond second-order in c, however. Employing these results, the effect of polydispersivity on the effective properties is examined. It is worth noting that, under some conditions, polydispersivity can actually lead to a slight decrease of the shear modulus, whereas, for highly conducting particles, polydispersivity always increases the effective conductivity.

37969 Island growth and coarsening in thin films—conservative and nonconservative systems. Atwater, H.A. (Thomas J. Watson Laboratory of Applied Physics, California Institute of Technology, Pasadena, California 91125 (USA)); Yang, C.M. *Journal of Applied Physics (USA),* 67(10): 6202-6213 (15 May 1990). DOE Contract FG03-89ER45395.

A model is developed for time-dependent growth and coarsening of islands in conservative and nonconservative thin-film systems with substrate coverages in the range $0<\Phi<0.5$. Solution of the continuity equation, for both matter-conservative and -nonconservative systems, coupled with mean-field or effective-medium rate laws for island coarsening, allows the evolution of arbitrary island size distributions to be modeled. For matter conservative systems with substrate coverage of $\Phi=0$, all distributions investigated approach the dynamically scaling distribution and the steady-state power-law coarsening rate predicted by analytic theory following from the work of Lifschitz and Slyozov [J. Phys. Chem. Solids **19**, 35 (1961)] and Wagner [Z. Electrochem. **65**, 581 (1961)]. When it is assumed that $\Phi>0$ but constant during coarsening, a dynamically scaling distribution and a steady state are also approached asymptotically. The form of the initial distribution has a significant effect on the coarsening kinetics in the transient regime before a dynamically scaling distribution is achieved. When the substrate coverage is allowed to vary for a conservative system, the coverage decreases monotonically with time. Simultaneous thin-film growth and coarsening in nonconservative systems (e.g., by vapor deposition, low-energy ion bombardment) is also examined. In particular, the relationship between growth and coarsening kinetics and mechanisms for ion-surface interactions is discussed.

37970 Electromagnetic radiation from doubly rotated piezoelectric crystal plates vibrating at thickness frequencies. Lee, P.C.Y. (Department of Civil Engineering and Operations Research, Princeton University, Princeton, New Jersey 08544 (USA)); Kim, Y.; Prevost, J.H. *Journal of Applied Physics (USA),* 67(11): 6633-6642 (1 Jun 1990). DOE Contract AC02-76CH03073.

Exact solution of the three-dimensional linear equations of piezoelectromagnetism is obtained for doubly rotated piezoelectric crystal plates surrounded by vacuum and excited by face traction. A generalized Poynting's theorem is derived for general media in which electromagnetic and mechanical fields interact with each other. For linear piezoelectric crystals it is shown that the generalized theorem may still be interpreted as an energy theorem, and hence densities of energy stored in the electric, magnetic, and elastic strain fields can be identified. Radiated power, per unit surface area and averaged over the period, and induced strain and electric fields in the middle plane of the plate are calculated for doubly rotated quartz plates whose cut orientations follow the upper and lower loci of zeros of the first-order temperature coefficient of frequency of the x_1 -thickness-shear mode. Quality factors and partition of stored energies are also examined.

37971 Pulsed-laser evaporation technique for deposition of thin films: Physics and theoretical model. Singh, R.K. (Department of Material Science and Engineering, North Carolina State University, Raleigh, North Carolina 27695-7916 (USA)); Narayan, J. *Physical Review, B: Condensed Matter (USA),* 41(13): 8843-8859 (1 May 1990).

We have studied in detail the physical phenomena involved in the interaction of high-powered nanosecond excimer-laser pulses with bulk targets resulting in evaporation, plasma formation, and subsequent deposition of thin films. A theoretical model for simulating these laser-plasma–solid interactions has been developed. In this model, the laser-generated plasma is treated as an ideal gas at high pressure and temperature, which is initially confined in small dimensions, and is suddenly allowed to expand in vacuum. The three-dimensional expansion of this plasma gives rise to the characteristic spatial thickness and compositional variations observed in laser-deposited thin films of multicomponent systems. The forward-directed nature of the laser evaporation process has been found to result from anisotropic expansion velocities of the atomic species which are controlled by the dimensions of the expanding plasma.

37972 Determination of the order of phase transitions in numerical simulations. McCarthy, J.F. (Department of Physics, Indiana University, Bloomington, Indiana 47405 (USA)). *Physical Review, B: Condensed Matter (USA),* 41(13): 9530-9533 (1 May 1990). DOE Contract AC02-84ER40125.

Simulations of the two-dimensional Potts model for the cases q=4,5, and 10 are described. Particularly, interest is given to comparing the q=4 and 5 models to observe what happens as the transition changes from second to first order.

37973 Anyons in the *XY* model induced by charged holes. Schmeltzer, D. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, NM (USA)); Bishop, A.R. *Physical Review, B: Condensed Matter (USA),* 41(13): 9603-9606 (1 May 1990).

We show that the inclusion of holes in a *XY* two-dimensional spin antiferromagnet gives rise to electrically charged particles which carry a flux. As a result two particles with the same electric charge can bind due to their opposite vorticity.

37974 Optical pulses in tritiated solid hydrogen. Mapoles, E.R. (Lawrence Livermore National Laboratory, Livermore, California 94550 (US)); Magnotta, F.; Collins, G.W.; Souers, P.C. *Physical Review, B: Condensed Matter (USA),* 41(16): 11653-11656 (1 Jun 1990). DOE Contract W-7405-ENG-48.

We report light-emission data from a solid deuterium-tritium sample between 2.4 and 4 K. We have measured the relative intensity as a function of temperature both from a steady-state background and pulsed flashes which we stimulate with a small heater. The pulse of light is believed to be related to heat spikes previously observed in tritiated solid hydrogen and allows a study of the dynamics of this process without coupling to the apparatus. The pulse of light does not have a sharp cutoff with temperature, but decreases in intensity and increases in duration with increasing temperature such that the area under the pulse is roughly constant between 2.4 and 4 K. We are able to confine most of the light to wavelengths longer than 780 nm.

37975 Vibrational properties of percolating clusters: Localization and density of states. Li, Q. (Ames Laboratory and

Department of Physics, Iowa State University, Ames, Iowa 50011 (USA)); Soukoulis, C.M.; Grest, G.S. *Physical Review, B: Condensed Matter (USA)*, 41(16): 11713-11716 (1 Jun 1990). DOE Contract W-7405-ENG-82.

The vibrational integrated density of states (DOS) of two-dimensional percolating clusters is calculated using a novel numerical technique. It is confirmed that the density of states is characterized by an $\omega^{1/3}$ power-law behavior in the fracton regime, while a transition to a Debye-type spectrum occurs at lower frequencies. The dependence of the crossover frequency ω_c and the coefficient A_D of the Debye term in the DOS on the concentration p of the percolating cluster are numerically determined. By use of finite-size scaling methods, the localized nature of all the vibrational modes is established. We find that the fracton states as well as the phonon states are exponentially localized. There is no evidence for fracton superlocalization. However, there is a power-law dependence of the localization length versus frequency in the fracton regime, which crosses over to an exponential dependence in the low-frequency regime.

6561 Superconductivity

Refer also to citation(s) 37209, 37221, 37228, 37233, 37242, 37245, 37254, 37260, 37269, 37270, 37467, 37941

37976 (CONF-900817–1) **Evidence of weak pair coupling in the penetration depth of bi-based high-T_c superconductors.** Thompson, J.R. (Tennessee Univ., Knoxville, TN (USA). Dept. of Physics); Sun, Yang Ren; Ossandon, J.G.; Christen, D.K.; Chakoumakos, B.C.; Sales, B.C.; Kerchner, H.R.; Sonder, E. Oak Ridge National Lab., TN (USA). [1990]. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From LT-19 satellite conference on high-temperature superconductivity; Cambridge (UK); 13-15 Aug 1990. Order Number DE90009415. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The magnetic penetration depth $\lambda(T)$ has been investigated in Bi(Pb)SrCaCuO high-$T_c$compounds having 2- and 3-layers of copper-oxygen per unit cell. Studies of the magnetization in the vortex state were employed and the results were compared with weak and strong coupling calculations. The temperature dependence of λ is described well by BCS theory in the clean limit, giving evidence for weak pair coupling in this family of materials. For the short component of the λ tensor, we obtain values of 292 and 220 nm (T = 0) for Bi-2212 and (BiPb)-2223, respectively.

37977 (DOE/ER/45326–3) **[Theory of exotic superconducting and normal states of heavy electron and high $T_c$materials]: [Progress report].** Ohio State Univ. Research Foundation, Columbus, OH (USA). Dept. of Physics. [1990]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER45326. Order Number DE90012688. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This paper discusses: quadrupole Kondo effect; heavy electron transport properties; quadrupolar fluctuation mechanism for high-$T_c$superconductors; research accomplishments for the t–J model of high-$T_c$superconductors; interpretation of high-$T_c$superconductors experimental data; and dynamics of strongly correlated systems. (LSP)

37978 (LA-UR–90-1013) **Principles of superconductor imaging surface gradiometry.** van Hulsteyn, D.B.; Overton, W.C. Jr.; Flynn, E.R. Los Alamos National Lab., NM (USA). [1990]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-900806–2: 19. international conference on low temperature physics, Brighton (UK), 16-22 Aug 1990). Order Number DE90008916. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Magnetic sources in the vicinity of superconducting surfaces produce images in such a way that a single pick-up coil parallel to the surface acts as a first order gradiometer. The principles will be described, together with specific discussions of the imaging by planar and spherical surfaces. The fact that these surfaces also deflect noise due to remote sources make this concept particularly appealing as a method for detecting extremely weak sources in a hostile environment. Possible applications to neuromagnetometry, corrosion detection and non-destructive evaluation will be discussed. 2 refs., 2 figs.

37979 (LBL–28749) **Pressure dependence of the specific heat of heavy-fermion $YbCu_{4.5}$.** Amato, A. (Lawrence Berkeley Lab., CA (USA)); Fisher, R.A.; Phillips, N.E.; Jaccard, D.; Walker, E. Lawrence Berkeley Lab., CA (USA). Mar 1990. 4p. Sponsored by U.S. DOE Energy Research; Swiss National Science Foundation. DOE Contract AC03-76SF00098. (CONF-900806–7: 19. international conference on low temperature physics, Brighton (UK), 16-22 Aug 1990). Order Number DE90011584. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The specific heat of a polycrystalline sample of $YbCu_{4.5}$ has been measured between 0.3 and 20K at pressures to 8.2 kbar. Unlike cerium-based heavy-fermion compounds, an increase of C/T is observed with increasing pressure, with the linear term enhanced by about 16% at 8.2 kbar. Above 7K, $(\partial C/\partial P)_T$ is negative. The nuclear contribution observed at P = 0 is increased by roughly a factor of two at 8.2 kbar. 7 refs., 3 figs.

37980 (LBL–28750) **Specific heat of $La_{2-x}Sr_xCuO_4$: Volume fraction of superconductivity; possible structural transition at 45K.** Amato, A. (Lawrence Berkeley Lab., CA (USA)); Fisher, R.A.; Phillips, N.E.; Torrance, J.B. Lawrence Berkeley Lab., CA (USA). Mar 1990. 5p. Sponsored by U.S. DOE Energy Research; Swiss National Science Foundation. DOE Contract AC03-76SF00098. (CONF-900806–8: 19. international conference on low temperature physics, Brighton (UK), 16-22 Aug 1990). Order Number DE90011585. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Specific heat measurements on $La_{1.85}Sr_{0.15}CuO_4$ show a linear correlation of the zero-field low-temperature linear term with the discontinuity at T_c, each of which provides a measure of the superconducting volume fraction. The correlation leads to an estimate of the normal-state density of electronic states which, together with the band structure calculated value, gives an electron-phonon interaction parameter that is too small to account for the superconductivity. For a sample with x=0.30 magnetic field insensitive anomaly in specific heat near 45K was observed which may be related to a structural phase transition. 10 refs., 3 figs., 1 tab.

37981 (PB–90-183500/XAB) **High-temperature superconductivity: Perseverance and cooperation on the road to commercialization.** Office of Science and Technology Policy, Washington, DC (USA). 20 Jun 1988. 46p. Available from NTIS, PC A03/MF A01.

Early in 1986 two European researchers working in the Swiss laboratory of a U.S. firm made a remarkable and unexpected discovery. After years of dedicated materials research they had in fact found a class of materials which exhibited the remarkable phenomenon of superconductivity at a new and higher range of temperatures. Scientifically, the result was completely unexpected. Technologically, the result immediately brought out of mothballs the many applications of superconductivity that had generally seemed out of reach with the earlier materials. The recommendations are in two parts, the first aimed at strengthening the purely scientific effort, and the second aimed at providing strength and stability in the long term race for applications.

37982 Forces upon vortices in anisotropic superconductors. Kogan, V.G. (Ames Laboratory— Department of Energy and Physics Department— Iowa State University, Ames, Iowa 50011 (USA)). *Physical Review Letters (USA)*, 64(18): 2192-2194 (30 Apr 1990). DOE Contract W-7405-ENG-82.

Forces on two parallel vortices in anisotropic materials are generally not directed along the line connecting the vortices. The interaction results not only in a repulsion but, in addition, in a torque. On a macroscopic scale, if the magnetic induction B or the anisotropy parameters m_{ik} change within a crystal, the flux-line lattice is subject to forces associated with spatial variation of the torque originated by anisotropy. This force is additional to and different from the Lorentz force, and both forces are, in general, comparable in magnitude.

37983 Fermions and solitons in the O(3) nonlinear σ model in 2+1 space-time dimensions. Voruganti, P. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309 (USA)); Doniach, S. *Physical Review, B: Condensed Matter (USA)*, 41(13): 9358-9365 (1 May 1990). DOE Contract AC03-76SF00515.

The field-theory limit of antiferromagnetism with holes is described using the O(3) nonlinear σ model. The minimal coupling to the spin wave gives a Pauli term that couples the hole charge density to the topological charge density for solitons. This term leads to drastic consequences: an attractive potential for holes and solitons, spin-charge coupling for the holes, and zero-momentum modes. The zero-momentum modes are exact nonperturbative solutions to the full coupled equations of motion for spin waves and holes. The effect of a Chern-Simons term, connections to other mean-field approaches, and the quantum bound-state problem are discussed. If the zero modes are the states of lowest energy, then the holes in this field-theory limit are attached to skyrmions.

37984 I-V characteristics in two-dimensional frustrated Josephson-junction arrays. Falo, F. (Theoretical Division and Advanced Studies Program, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (US)); Bishop, A.R.; Lomdahl, P.S. *Physical Review, B: Condensed Matter (USA)*, 41(16): 10983-10993 (1 Jun 1990).

Langevin molecular-dynamics simulations of two-dimensional Josephson-junction arrays in a uniform external magnetic field are presented. I-V characteristics for zero and finite temperature are calculated. The voltage response is analyzed in terms of the dynamical behavior of defects with respect to the ground-state flux lattice—domain walls and vortex-antivortex pairs. At zero temperature, several spatio-temporal regimes as a function of I are found: (i) a superconducting phase (V=0) corresponding to the locking of the flux lattice; (ii) a "chaotic" response related to domain walls nearly pinned by the discreteness of the underlying flux lattice; and (iii) two phases with ac response corresponding to different periodic domain-wall lattice patterns. At finite temperatures the response is modified by the nucleation of transverse structure (vortex-antivortex pairs) on the moving domain walls. This instability can enhance or inhibit the voltage response depending on the domain-wall structure. A phase diagram of the different dynamical regimes is proposed.

37985 Renormalization from density-functional theory to strong-coupling models for electronic states in Cu-O materials. Hybertsen, M.S. (AT&T Bell Laboratories, 600 Mountain Avenue, Murray Hill, New Jersey 07974 (USA)); Stechel, E.B.; Schluter, M.; Jennison, D.R. *Physical Review, B: Condensed Matter (USA)*, 41(16): 11068-11072 (1 Jun 1990). DOE Contract AC04-76DP00789.

Strong-coupling models for the electronic structure of La_2CuO_4 are derived from the local-density-functional results in two successive stages of renormalization. First, a three-band Hubbard model is derived with parameters explicitly calculated from first principles using a constrained density-functional approach and a mean-field fit to the Cu-O $pd\sigma$ bands. Second, exact diagonalization studies of finite clusters within the three-band Hubbard model are used to select and map the low-energy spectra onto effective one-band Hamiltonians, e.g., the Heisenberg, one-band Hubbard, or "t-t'-J" model. At each stage, calculated observables are in quantitative agreement with experiment.

37986 Shape of the upper-critical-field curves in URu_2Si_2: Evidence for anisotropic pairing. Kwok, W.K. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439 (USA)); DeLong, L.E.; Crabtree, G.W.; Hinks, D.G.; Joynt, R. *Physical Review, B: Condensed Matter (USA)*, 41(16): 11649-11652 (1 Jun 1990). DOE Contract W-31-109-ENG-38.

Measurements of the upper critical magnetic field H_{c2} of single-crystal URu_2Si_2 are reported for fields $H \leq 8$ T and temperatures $T \geq 0.5$ K. H_{c2} is strongly anisotropic and exhibits pronounced positive curvature for $\mathbf{H} \| \mathbf{a}$ in the tetragonal basal plane. These features can be explained using a theoretical model that assumes a multicomponent superconducting order parameter that is strongly coupled to the antiferromagnetic moment.

6570 Theoretical and Mathematical Physics

Refer also to citation(s) 37814, 37818, 38054

37987 (CONF-900466–64) **Multiple scattering theory for space filling potentials.** Butler, W.H. (Oak Ridge National Lab., TN (USA)); Brown, R.G.; Nesbet, R.K. Oak Ridge National Lab., TN (USA). [1990]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Spring meeting of the Materials Research Society; San Francisco, CA (USA); 16-21 Apr 1990. Order Number DE90012940. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Multiple scattering theory (MST) provides an efficient technique for solving the wave equation for the special case of muffin-tin potentials. Here MST is extended to treat space filling non-muffin tin potentials and its validity, accuracy and efficiency are tested by application of the two dimensional empty lattice test. For this test it is found that the traditional formulation of MST does not coverage as the number of partial waves is increased. A simple modification of MST, however, allows this problem to be solved exactly and efficiently. 15 refs., 3 tabs.

37988 (DOE/ER/45378–2) **Quantum transport in mesoscopic systems: Annual technical report, September 1989–September 1990.** Feng, Shechao. California Univ., Los Angeles, CA (USA). [1990]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-88ER45378. Order Number DE90012808. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper reports on the results of research on a new anisotropy of electron systems in a magnetic field. 4 refs. (FSD)

37989 (EP-CPHT-RA–1988) **Theoretical physics.** Laval, G. (Centre National de la Recherche Scientifique (CNRS), 75 - Paris (FR)). Ecole Polytechnique, 91 - Palaiseau (France). 1988. 29p. (In French). Order Number DE90500850. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the theoretical Physics Center (Ecole Polytechnique, France), is presented. The research activities are carried out in the fields of the supersymmetry theory, the dynamic systems theory, the statistical mechanics, the plasma physics and the random media. Substantial improvements are obtained on dynamical system investigations. In the field theory, the definition of the Gross-Neveu model is achieved. However the construction of the non-abelian gauge theories and the conformal theories are the main research activities. Concerning Astrophysics, a three-dimensional gravitational code is obtained. The activities of each team, and the list of the published papers, congress communications and thesis are given.

37990 (EP-MAP-RA–1988) **Applied mathematics.** Nedelec, J.C. Ecole Polytechnique, 91 - Palaiseau (France). 1988. 23p. (In French). Order Number DE90500866. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the Applied Mathematics center (Polytechnic School, France), is presented. The research fields of the Center are the scientific calculus, the probabilities and statistics and the video image synthesis. The research topics developed are: the analysis of numerical methods, the mathematical analysis of the physics and mechanics fundamental models, the numerical solution of complex models related to the industrial problems, the stochastic calculus and the brownian movement, the stochastic partial differential equations, the identification of the adaptive filtering parameters, the discrete element systems, statistics, the stochastic control and the development, the image synthesis techniques for education and research programs. The published papers, the congress communications and the thesis are listed.

37991 (EP-MAT-RA–1988) **Mathematics.** Demazure, M. Ecole Polytechnique, 91 - Palaiseau (France). 1988. 25p. (In French). Order Number DE90500864. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the Mathematics center (Polytechnic School, France), is presented. The Center is composed of different research teams: analysis, Riemann geometry, group theory, formal calculus and algorithm geometry, dynamical systems, topology and singularity. For each team, the members, the research topics, the

national and international cooperations, are given. The papers concerning the investigations carried out in 1988, are listed.

37992 (LA-UR-90-1866) **Important experiments to test for longer-ranged new gravitational forces.** Nieto, M.M.; Goldman, T. Los Alamos National Lab., NM (USA). [1990]. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-900822-3: 25. IUPAP international conference on high energy physics, Singapore (Singapore), 2-8 Aug 1990). Order Number DE90012102. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We discuss four experiments, three of which are underway, and find them to be of critical importance in testing for longer-range, static, non-Newtonian gravity. 21 refs.

37993 (LITH-MAT-R-89-29) **Scattering theory for self-adjoint extensions.** Kuperin, Yu.A. (Instituto Nazionale di Fisica Nucleare, Rome (Italy)); Pavlov, B.S.; Kurasov, P.B.; Makarov, K.A.; Melnikov, Yu. B.; Yevstratov, V.V. Linkoeping Univ. (Sweden). Dept. of Mathematics. 10 Oct 1989. 211p. Order Number DE90630604. Available from NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS.

In this paper a new approach is suggested to the construction of a wide class of exactly solvable quantum-mechanical models of scattering, quantum-mechanical models of solids and an exactly solvable quantum-stochastical model. For most of the models the spectral analysis is performed in an explicit form, for many body problems it is reduced to one-dimensional integral equations. The construction of all models is based on a new version of extension theory, which uses the boundary forms for abstract operators. This version gives a simple and general method to join the pair of operators, one of them abstract, and the other one differential. The solvability of these models is based on Krein's formula for quasiresolvents.

37994 Dispersion relations for causal Green's functions: Derivations using the Poincare–Bertrand theorem and its generalizations. Davies, K.T.R. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6373 (USA)); Davies, R.W.; White, G.D. *Journal of Mathematical Physics (New York) (USA),* 31(6): 1356-1373 (Jun 1990). DOE Contract AC05-84OR21400.

A famous theorem by Poincare and Bertrand formally describes how to interchange the order of integration in a double integral involving two principal-value factors. This theorem has important applications in many-body physics, particularly in the evaluation of response functions (or "loop integrals") at either zero or finite temperatures. Of special interest is the loop containing an integration with respect to the energy of two causal propagators. It is shown that such a response function with two boson or two fermion lines behaves statistically like a boson, while the response function containing a boson and a fermion behaves like a fermion. Examples are given of typical loop integrals occurring in the solution of Dyson's equations for nuclear matter in the presence of delta, nucleon, and pion interactions. A "form factor" that is essential for the convergence of the nucleon–pion loop integral is chosen to have little effect on the analogous nucleon–delta loop integral. The Poincare–Bertrand (PB) theorem is then generalized to multiple integrals and higher-order poles. From the generalization of the theorem to triple integrals, it is shown that causality is rigorously maintained, at zero temperature, for convolutions with respect to the time of products of Green's functions and thus for Dyson's equations. Also, for finite temperature, the three-propagator loop integral satisfies the statistics appropriate for the loop as a whole, in direct analogy with the result for the two-propagator loop. The intimate connection between the PB theorem and analyticity (or causality) is clearly demonstrated. Although this work considers explicitly only nuclear physics examples, the results are relevant to other fields where many-body theory is used.

37995 Explicit construction of nontrivial elements for homotopy groups of classical Lie groups. Lundell, A.T. (Department of Mathematics, University of Colorado, Campus Box 426, Boulder, Colorado 80309 (USA)); Tosa, Y. *Journal of Mathematical Physics (New York) (USA),* 31(6): 1494-1502 (Jun 1990). DOE Contract AC02-86ER40253.

Nontrivial elements of homotopy groups for unitary, orthogonal, and symplectic groups are given *explicitly*. In particular, (a) representatives of generators of nontrivial homotopy groups of stable special unitary, orthogonal, and symplectic groups are constructed using Clifford algebras; (b) the values for "winding numbers" for stable SU, SO, and Sp are calculated for generators of homotopy groups; and (c) representatives of generators of homotopy groups $\Pi_{n-2}(O(n-1))$, $\Pi_{2n-2}(U(n-1))$, $\Pi_{4n-2}(\mathrm{Sp}(n-1))$ are given.

37996 The unitary irreducible representations of SU(2,1). Bars, I. (Physics Department, University of Southern California, Los Angeles, California 90089-0484 (US)); Teng, Z. *Journal of Mathematical Physics (New York) (USA),* 31(7): 1576-1586 (Jul 1990). DOE Contract FG03-84ER40168.

This paper analyzes the irreducible unitary representations of SU(2,1) in a basis labeled as $|p, q; jmy\rangle$, where p,q correspond to quantum numbers associated with the quadratic and cubic Casimir operators, j,m label states of the SU(2) subgroup, and y labels the quantum number with respect to the U(1) subgroup. All the irreducible representations are found and the allowed range of these quantum numbers for each representation are given. The results are expressed in the form of diagrams that show the allowed values in a (j,y) plot for fixed values of p,q. A (p,q) plot is also provided that indicates the allowed values of these quantum numbers.

37997 Multivariable biorthogonal continuous–discrete Wilson and Racah polynomials. Tratnik, M.V. (Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Church Street S. E., Minneapolis, Minnesota 55455 (USA)). *Journal of Mathematical Physics (New York) (USA),* 31(7): 1559-1575 (Jul 1990).

Several families of multivariable, biorthogonal, partly continuous and partly discrete, Wilson polynomials are presented. These yield limit cases that are purely continuous in some of the variables and purely discrete in the others, or purely discrete in all the variables. The latter are referred to as the multivariable biorthogonal Racah polynomials. Interesting further limit cases include the multivariable biorthogonal Hahn and dual Hahn polynomials.

37998 Influence of anisotropy on the dispersion characteristics of guided ultrasonic plate modes. Li, Y. (Ames Laboratory, Ames, IA (USA)); Thompson, R.B. *Journal of the Acoustical Society of America (USA),* 87(5): 1911-1931 (May 1990).

Dispersion curves are developed for elastic wave propagation in an anisotropic plate of monoclinic or higher symmetry. Emphasis is placed on analytic expressions for various features. Generalization of the isotropic Rayleigh–Lamb dispersion relations are derived for the cases of (a) propagation along a material symmetry axis and (b) propagation in a general direction. Examination of the high-frequency limit of the lowest symmetric and antisymmetric mode dispersion curves yields expressions for the half-space surface or Rayleigh wave velocity. It is shown that the dispersion curves for these modes can exhibit multiple crossings in approaching this limit, and an analytic solution is presented for the constant crossing interval that occurs for propagation along symmetry directions. The analytic results are illustrated by extensive numerical calculations for a variety of degrees of anisotropy with emphasis placed on the relationship between the slowness curves governing partial wave propagation and various features of the dispersion curves.

37999 Effective one-loop scalar Lagrangian in no-scale supergravity models. Burton, J.W. (Lawrence Berkeley Laboratory, Berkeley, California (USA)); Gaillard, M.K.; Jain, V. *Physical Review, D (Particles Fields) (USA),* 41(10): 3118-3148 (15 May 1990). DOE Contract AC03-76SF00098.

The total one-loop effective scalar Lagrangian is given in an explicitly field-redefinition-invariant form for a general model with derivative self-couplings of the scalars and scalar couplings to graviton, gauge, and fermion fields. This result is then specialized to no-scale models, with a form of the Kaehler potential that is suggested by the zero-slope limit of superstring theories.

38000 Propagators for shape-invariant potentials. Das, A. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627 (US)); Huang, W. *Physical Review, D*

(Particles Fields) (USA), 41(10): 3241-3247 (15 May 1990). DOE Contract AC02-76ER13065.

We derive recursion relations for the propagators of shape-invariant potentials both in the operator formulation as well as in the path-integral formulation. This allows us to determine the form of the propagators recursively. We evaluate the propagators explicitly, for several shape-invariant potentials, using this method.

38001 Diffusion in symplectic maps. Kook, H. (Institute for Fusion Studies, University of Texas, Austin, Texas 78712 (USA)); Meiss, J.D. *Physical Review, A (General Physics) (USA)*, 41(8): 4143-4150 (15 Apr 1990). DOE Contract FG05-80ET53088.

The characteristic function method is used to obtain the diffusion tensor for symplectic maps. At lowest order the quasilinear result is obtained, and a series in higher-order correlations is developed. Comparison of the theory to numerical experiments is given using a four-dimensional example of Froeschle. The experiments agree well with the theory for moderately large parameters. Arnol'd diffusion for the "thick-layer" case is discussed. It is shown that the short-time correlations in one canonical plane affect the diffusion in the other plane even in the limit of zero coupling. Accelerator modes exist for the Froeschle example and cause divergences in the diffusion, but these only appear when the accelerating region is included in the ensemble.

38002 Multipolar contributions to optical second-harmonic generation in isotropic fluids. Zhu, X.D. (Department of Physics, University of California, Berkeley, California 94720 (USA)); Shen, Y.R. *Physical Review, A (General Physics) (USA)*, 41(8): 4549-4549 (15 Apr 1990). DOE Contract AC03-76SF00098.

The general conclusions of the recent article by Andrews and Blake [Phys. Rev. A 38, 3113 (1988)] on the forbidden nature of higher-order multipolar contributions to optical second-harmonic generation are misleading and not generally valid.

38003 Multimode squeeze operators and squeezed states. Ma, X. (Department of Chemistry, Florida State University, Tallahassee, Florida 32306 (USA)); Rhodes, W. *Physical Review, A (General Physics) (USA)*, 41(9): 4625-4631 (1 May 1990). DOE Contract FG05-86ER60473.

Multimode squeeze and rotation operators are defined such that they have extremely similar algebraic properties as those of their single-mode counterparts. It is shown that the introduction of *N*-mode squeeze operators provides a convenient set of parameters to describe the variances of the quadrature amplitudes in multimode Gaussian squeezed states. Some important properties of these *N*-mode unitary operators are investigated. It is also shown that the time-evolution operator for a general *N*-mode quadratic Hamiltonian can be conveniently expressed as an operator product containing an *N*-mode squeeze operator, an *N*-mode rotation operator, and an *N*-mode displacement operator.

38004 Scaling pattern of period doubling in four dimensions. Kim, S. (Department of Physics, Kangwon National University, Chunchon, Kangwon-Do 200-701, (Korea)); Hu, B. *Physical Review, A (General Physics) (USA)*, 41(10): 5431-5440 (15 May 1990). DOE Contract FG05-87ER40374.

The period-*M* (*M*=1 and 2) scaling pattern of period doubling in a symmetric four-dimensional volume-preserving map is studied. The period-doubling sequence repeats itself asymptotically from one bifurcation to the next in a period-1 bifurcation route, and to every other one in a period-2 bifurcation route. The parameter-scaling factors γ_1 and γ_2 in a bifurcation route depend on the bifurcation path. They are some combination of δ_1 and δ_2 (divergence rates from the period-*M* map of the renormalization transformation) and δ_1' and δ_2' (convergence rates to the period-*M* map). Therefore each bifurcation route is characterized by these four scaling factors. The values of δ_1, δ_2, δ_1', and δ_2' are obtained by a numerical calculation and a renormalization analysis. We find that there are three kinds of period-1 scaling patterns and one kind of period-2 scaling pattern. δ_1 and δ_1' in any bifurcation route are the same as those in area-preserving maps; however, δ_2 and δ_2' depend on the bifurcation route.

38005 Quantum logistic map. Goggin, M.E. (Physics Department, New Mexico State University, Las Cruces, New Mexico 88003 (USA)); Sundaram, B.; Milonni, P.W. *Physical Review, A (General Physics) (USA)*, 41(10): 5705-5708 (15 May 1990).

By coupling a kicked quantum system to a bath of harmonic oscillators we derive a logistic map with quantum corrections. We find a period-doubling route to the classical behavior as a dissipation parameter is increased, and other interesting features at intermediate values of this parameter.

38006 Sign problem in the numerical simulation of many-electron systems. Loh, E.Y. Jr. (Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, NM (USA)); Gubernatis, J.E.; Scalettar, R.T.; White, S.R.; Scalapino, D.J.; Sugar, R.L. *Physical Review, B: Condensed Matter (USA)*, 41(13): 9301-9307 (1 May 1990). DOE Contract FG03-85ER45197.

We discuss the problems that arise in the numerical simulation of many-electron systems when the measure of the functional integrals is not positive definite. We present theoretical arguments and numerical data which indicate that the expectation value of the sign of the measure decreases exponentially as the inverse temperature β increases, unless the measure is forced to be positive by an explicit symmetry. We therefore conclude that a recent proposal for dealing with the sign problem due to Sorella *et al.* Leads to an uncontrolled approximation. In the cases we have studied it is a good approximation for the ground-state energy, and we present a method for calculating the correction needed to make it exact. However, for some physical quantities, such as the *d*-wave pair field susceptibility, the neglect of signs can yield misleading results.

70 FUSION ENERGY

Refer also to citation(s) 37709, 37952

38007 (Y/DK–669) **Cold fusion studies: Part 1, Preliminary results from an investigation of the possibility of electrochemically induced fusion of deuterium in palladium and titanium cathodes.** Hembree, D.M. (Oak Ridge Y-12 Plant, TN (USA)); Burchfield, L.A.; Fuller, E.L. Jr.; Perey, F.G.; Mamantov, G. Oak Ridge Y-12 Plant, TN (USA). 14 Jun 1990. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OS21400. Order Number DE90012885. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A series of experiments designed to detect the by-products expected from deuterium fusion occurring in the palladium and titanium cathodes of heavy water (D_2O) electrolysis cells is reported. The primary purpose of this account is to outline the integrated experimental design developed to test the cold fusion hypothesis and to report preliminary results that support continuing the investigation. Apparent positive indicators of deuterium fusion were observed, but could not be repeated or proved to originate from the electrochemical cells. In one instance, two large increases in the neutron count rate, the largest of which exceeded the background by 27 standard deviations, were observed. In a separate experiment, one of the calorimetry cells appeared to be producing ~18% more power that the input value, but thermistor failure prevented an accurate recording of the event as a function of time. In general, the tritium levels in most cells followed the slow enrichment expected from the electrolysis of D_2O containing a small amount of tritium. However, after 576 hours of electrolysis, one cell developed a tritium concentration approximately seven times greater than expected level. 3 refs., 6 figs., 1 tab.

7001 Plasma Research

Refer also to citation(s) 37416, 37503, 37516, 37715, 37720, 38201, 38259, 38275, 38276, 38279, 38280, 38285, 38289, 38290, 38291, 38296, 38299, 38300, 38301, 38304, 38322

38008 (CONF-891007–Vol.2, pp. 834-837) **Structural eddy current effects on plasma equilibrium and current induction in the IGNITEX experiment.** Dong, J.Q. (Univ. of Texas, Austin (USA)); Montalvo, E.; Carrera, R.; Rosenbluth, M.N. Oak Ridge

National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

In the IGNITEX device the plasma is surrounded by massive conducting material composed of several layers. From inside to outside the layers may be categorized as: first wall-vacuum vessel, poloidal field magnet system, inner toroidal field magnet region with slits and outer homogeneous toroidal field magnet region divided into twelve sectors. The 2-D finite element program PROTEUS is employed to study current induction and plasma equilibrium throughout the ignition discharge. Some modifications of the original code PROTEUS which permit the study of compact plasmas with strong wall coupling are described. The structure layers are simulated either as diffusive or as a set of electric circuits properly connected. Different resistivity models are considered. The calculations presented here show that the flux swing produced by the poloidal field (PF) coil system is enough to induce over 12 MA of plasma current and that a sequence of equilibrium configurations with elliptical cross sections can be obtained by properly choosing the waveforms of the PF system currents throughout the discharge of 10 seconds. The effects of the eddy currents on the discharge are dependent on the resistivities of the material and are substantial if the resistivities are low. Thus, the importance of a consistent equilibrium calculation coupling plasma, coils and structures is demonstrated. 5 figs., 13 figs.

38009 (CONF-891007–Vol.2, pp. 838-841) **Cavity resonance mode plasma breakdown for the IGNITEX experiment.** Eways, S.E. (Univ. of Texas, Austin (USA)); Booth, W.D.; Carrera, R.; Oakes, M.E.; Jaeger, E.F. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Radio frequency cavity resonance mode breakdown for the IGNITEX experiment is studied. It is shown using an average electron calculation that the ionization rate is much larger than the loss rate and breakdown can be achieved with modest RF power. The cavity resonance mode favorable for breakdown is the $TM_{(0,1,1)}$ which has a resonance frequency of 246.5 MHz. 12 refs., 3 figs.

38010 (CONF-891007–Vol.2, pp. 842-845) **Assessment of possible high-energy neutral beam injection in DIII-D.** Bhadra, D.K. (General Atomics, San Diego, CA (USA)); Kim, Jinchoon. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC03-89ER51114. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The feasibility of injecting high energy neutral particle beam in the DIII-D tokamak is examined. From numerical calculations of beam deposition, beam losses, and current drive, it is concluded that neutral beam injection up to an energy of 300 to 500 keV is viable. The effect of multistep excitation processes on the enhancement of the ionization cross-section of the energetic neutral particles works out to be beneficial for such a possible experiment. The knowledge obtained from such experiments would be essential for design, planning, and success for future large tokamak devices that will employ negative-ion based, high energy neutral beam injectors. 5 refs., 7 figs., 1 tab.

38011 (CONF-891007–Vol.2, pp. 1226-1229) **Fusion physics study of the IGNITEX experiment.** Montalvo, E. (Univ. of Texas, Austin (USA)); Carrera, R.; Ordonez, C.; Van Dam, J.; Xiao, H.; Helton, J.; Hively, L.; Howe, H.; Miley, G.; Rosenbluth, M.N. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The IGNITEX experiment can be realized in a single-turncoil tokamak which should ohmically heat a D-T mixture to thermonuclear conditions. Present knowledge on fusion physics indicates that the experiment has a high probability for ignition and that a thermally stable ignited phase can be produced. The fusion physics characteristics of the experiment are discussed here. The regime of operation appropriate for an ignition experiment is described. The various aspects of equilibrium, stability, transport, alpha containment, thermal runaway, alpha-induced modes, radiation emission, and plasma discharge transient are summarized. 8 refs., 1 fig., 3 tabs.

38012 (CONF-891007–Vol.2, pp. 1271-1273) **The control of plasma parameters to avoid high current disruptions in JET.** Tanga, A. (JET Joint Undertaking, Abingdon (England)); Lowry, C.; Lomas, P.; Garribba, M.; Johnson, M.F.; Noll, P.; Tubbing, B. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Disruptions at high plasma current in JET are a serious operational problem because of thermal overloading of in-vessel components and mechanical stresses due to induced currents. Empirically determined operating space have been mapped, which determine the operating condition free of disruptions both for X-point and limiter configurations. In JET there are three causes of disruption: (1) MHD induced disruptions, (2) Density limit, (3) Vertical instabilities. In order to avoid disruptions three operational diagrams have been empirically created which define operationally stable regions: (1) Gross MHD stability is described by a plasma internal inductance versus safety factor (ℓi vs q_ψ) diagram; (2) Density limit disruptions can be described by Hugill diagram; (3) Stability diagram for vertical instability, in terms of plasma elongation versus plasma current. This paper describes the JET operation space of parameters and the means to control the plasma parameters to stay within the boundaries. 10 refs., 5 figs.

38013 (CONF-891007–Vol.2, pp. 1274-1277) **Passive vertical stability of ITER (International Thermonuclear Experimental Reactor).** Leuer, J.A. (General Atomics, San Diego, CA (USA)); Wesley, J.C. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Next generation tokamaks, such as the International Thermonuclear Experimental Reactor (ITER), are being designed with high plasma current carrying capability. High current is best achieved by increasing the plasma elongation; however, this leads to a plasma configuration which is unstable to axisymmetric vertical motion of the plasma. Passive conductors must be included in the design to stabilize this vertical motion. In this paper, the authors analyze the passive stability property of the Physics Phase (PP) operation of the ITER device. A linearized, rigid-body assumption is used to predict the stability parameter of the proposed passive stabilization structure. The problem is formulated into an eigenvalue problem and the solution predicts the critical stability margin and characteristic growth rate. The proposed stabilization structure and vacuum vessel (VV) provides 50% margin against Alfven time scale vertical motion. The growth rate is less than 50 s^{-1} for the nominal plasma. The plasma is shown to have low growth rates over a range of plasma internal inductance and poloidal beta. 3 refs., 5 figs., 5 tabs.

38014 (CONF-891007–Vol.2, pp. 1278-1282) **MHD equilibrium and stability considerations for high-aspect-ratio ARIES-I tokamak reactors.** Peng, Y.K.M. (Oak Ridge National Lab., TN (USA)); Strickler, D.J.; Hogan, J.T.; Whitson, J.C.; Bathke, C.G.; Evans, K. Jr.; Jardin, S.C.; Klasky, M.; Leuer, J.A. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single

Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The requirements of an (1) external poloidal field coil (PFC) system with minimum stored energy, (2) double-null divertor plasmas with elongated D shape, (3) adequate passive stabilization of plasma vertical displacement by a vacuum vessel located behind the blanket zone, and (4) an enhanced plasma beta limit in the first stability regime are incorporated in the ARIES-I concept for a high-field tokamak reactor with high aspect ratio (A = 4.5). The plasma current and pressure profiles are also made consistent with enhanced bootstrap current I_{bs} and reduced current drive power by means of ion cyclotron wave (ICW) or neutral beam (NB) injection. These lead to plasmas characterized by an elongation κ_x of 1.8 to the divertor X-point, a triangularity δ_x of 0.7, a safety factor q on axis of $q_0 \approx 1.5$, a safety factor at the edge $q_{95} > 4$, a plasma beta $\beta \approx 2\%$, and a poloidal beta given by $\epsilon\beta_p \approx 0.5$ ($\epsilon = 1/A$). With a plasma current I_p of 11 MA, a toroidal field B_t of 13 T at the major radius R_0 of 6.5 m, and over 3.5 m of clearance between the PFCs and the plasma edge, the stored energy in the PFC system ranges from 20 GJ during plasma operation at low beta to 12 GJ during plasma operation at high beta. 16 refs., 6 figs., 2 tabs.

38015 (CONF-891007–Vol.2, pp. 1287-1290) **Experimental program and diagnostics for IGNITEX.** Booth, W.D. (Univ. of Texas, Austin (USA)); Carrera, R.; Hallock, G.; Elevant, T. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A conceptual experimental program and diagnostics system for the IGNITEX experiment is presented. The three-year, three phase program begins with approximately one year of hydrogen operation during which basic machine control (density and temperature profiles) and diagnostic system refinement will take place. Additionally, scaling law studies will be initiated here. The very high magnetic field and high density regimes accessible by IGNITEX should allow exploration of scaling laws in regimes which are inaccessible with present machines. Deuterium will be used in the second phase which will result in the production of limited fusion neutrons to allow preliminary testing of the neutron detector systems. When conditions approaching ignition have been reached, T will replace hydrogen in the fuel mixture for the final phase of operation. During the D-T phase the primary studies will concern the physics of ignition and the study of the fusion α particle effects on the plasma including α particle loss rate as well as confinement degradation and destabilization. Diagnostic support for IGNITEX will consist of two groups of instruments. The basic diagnostics group will include conventional magnetic pick-up coils for plasma position, current, and loop voltage, a 90° Thomson scattering system and an ECE system for electron temperature measurement, visible and UV spectrometers for impurity monitoring, and an FIR system for density profile measurement. The additional diagnostics for the latter phases of operation will include a foil absorption system for escaping α particles and a time-of-flight neutron spectrometer for neutron emission and ion temperature measurements. A review of possible plasma diagnosis available for neutron detection is included. 3 refs., 4 figs., 1 tab.

38016 (CONF-900264–7) **Effect of the equilibrium magnetic field on plasma edge fluctuations.** Carreras, B.A.; Leboeuf, J.N.; Lee, D.K.; Holmes, J.A.; Lynch, V.E. Oak Ridge National Lab., TN (USA). [1990]. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Topical conference on research trends in nonlinear and relativistic effects in plasmas; San Diego, CA (USA); 5-8 Feb 1990. Order Number DE90012720. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The magnetic field structure reflected in the safety factor (q) profile can play an important role in defining some of the basic structures of the magnetohydrodynamic (MHD) turbulence: it plays a role in the generation of spatial structures in the initial nonlinear phase, and it gives a radial dependence to the spectral average of the square of the poloidal mode number, $\langle m^2 \rangle^{1/2}$, that can modify the explicit dependences of an analytically derived expression for turbulence-induced anomalous losses. 12 refs., 4 figs.

38017 (CONF-900557–10) **Application of the results of carbon pellet modeling to the problem of plasma penetration.** Vahala, L.L. (Old Dominion Univ., Norfolk, VA (USA)); El Cashlan, A.G.; Gerdin, G.A.; Parks, P.B. Old Dominion Univ., Norfolk, VA (USA). [1990]. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER53278. From 8. topical conference on high-temperature plasma diagnostics; Hyannis, MA (USA); 6-10 May 1990. Order Number DE90012713. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The assumptions of the evaporation model for low-Z pellets interacting with magnetic fusion plasmas developed by P. B. Parks are tested. These assumptions are that the vapor density profile in the region adjacent to the pellet surface, falls off with radial distance as $r^{-\alpha}$, where $5 < \alpha < 6$, and that the ionization time for the transition between charge states τ_{zi}, is much less than a flow time for the vapor in this same region τ_f (i.e. for $r < \sim 3$ sonic radii). The first assumption is tested by solving a two-parameter eigenvalue problem for the evaporation cloud in the region interior to the sonic radius; the results are found to be consistent with the low-Z evaporation model. The second assumption, that $\tau_{zi} \ll \tau_f$, is tested at the sonic radius using the results from atomic physics and the low-Z evaporation model. It is found that indeed $\tau_{zi} \ll \tau_f$ for plasmas with parameters close to thermonuclear conditions (e.g. TFTR and CIT), but not for those of smaller Tokamaks such as TEXT. The results of pellet penetration calculations for the conditions of the TEXT carbon-pellet injection experiments are presented which show better agreement with experiment if the shielding fraction is calculated at each step of the pellet-penetration calculation, the effect of ionization is ignored, and if the effect of possible uncertainties in the background plasma parameters is included. 14 refs., 3 figs., 3 tabs.

38018 (CONF-9007113–1) **Effect of the radial electric field on turbulence.** Carreras, B.A.; Lynch, V.E. Oak Ridge National Lab., TN (USA). [1990]. 34p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Workshop on transport and confinement in toroidal devices; Santander (Spain); 2 Jul 1990. Order Number DE90012936. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

For many years, the neoclassical transport theory for three- dimensional magnetic configurations, such as magnetic mirrors, ELMO Bumpy Tori (EBTs), and stellarators, has recognized the critical role of the radial electric field in the confinement. It was in these confinement devices that the first experimental measurements of the radial electric field were made and correlated with confinement losses. In tokamaks, the axisymmetry implies that the neoclassical fluxes are ambipolar and, as a consequence, independent of the radial electric field. However, axisymmetry is not strict in a tokamak with turbulent fluctuations, and near the limiter ambipolarity clearly breaks down. Therefore, the question of the effect of the radial electric field on tokamak confinement has been raised in recent years. In particular, the radial electric field has been proposed to explain the transition from L-mode to H-mode confinement. There is some initial experimental evidence supporting this type of explanation, although there is not yet a self-consistent theory explaining the generation of the electric field and its effect on the transport. Here, a brief review of recent results is presented. 27 refs., 4 figs.

38019 (CONF-9007113–2) **Resistive MHD turbulence.** Carreras, B.A. Oak Ridge National Lab., TN (USA). [1990]. 71p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Workshop on transport and confinement in toroidal devices; Santander (Spain); 2 Jul 1990. Order Number DE90012935. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

Plasma turbulence studies based on fluid equations are useful to develop an understanding of key concepts in magnetized plasma turbulence theory, and they have the potential to explain the plasma edge fluctuations and anomalous transport. Computers with the numerical resolution required for carrying out the necessary computational studies have only recently become available. The coupling between analytical and computational studies has led in

recent years to progress in building up turbulence theory and testing renormalization prescriptions. In this paper, the resistive pressure-gradient-driven turbulence is reviewed to illustrate these points. An extended version of this paper will be published in Fizica Plazmy.

38020 (DOE/DP/10697–T1) **X-ray crystal devices for measuring compression and stability of laser fusion targets: Final report.** Post, B. Polytechnic Inst. of New York, Brooklyn, NY (USA). Dept. of Physics. May 1990. 42p. Sponsored by U.S. DOE Defense Programs. DOE Contract AS03-87DP10697. Order Number DE90011439. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The major goals of this investigation were: (a) the development of a method for two-dimensional imaging of x-rays using simultaneous n-beam diffraction within crystals, and (b) the application of the above to the study of the stability of laser irradiated spherical targets by imaging x-ray line emission from thin metallic layers imbedded within plastic shell targets. To date, we have completed part (a) by identifying and characterizing n-beam maxima diffracted by a perfect Germanium crystal. We have used such diffraction to image test objects and to demonstrate the possibility of achieving satisfactory spatial resolution; these techniques will be used to image target emission. Part (b) will be completed in the near future. An x-ray camera which utilizes a Germanium crystal for monochromatic imaging is being fabricated. The camera is small (largest dimension approximately 7 cm) to enable us to position it approximately 5 cm from the target. As explained below, the finite spectral bandwidth of the crystal, and increasing the distance from the target, both lead to degradation of spatial resolution. Results of those studies are summarized. In addition to imaging, simultaneous diffraction of x-rays within crystals makes possible other applications, some of which are described below. One involves the substantial reduction of absorption of x-rays along directions which satisfy diffraction conditions with respect to several sets of crystal planes. We have demonstrated such reduction in absorption for various cases of simultaneous diffraction in Germanium. These are summarized.

38021 (DOE/ER/53194–3) **Nonlinear magnetohydrodynamics: Progress report, January 1, 1989–June 30, 1990.** Montgomery, D.C. Dartmouth Coll., Hanover, NH (USA). Jun 1990. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER53194. Order Number DE90013436. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This paper discusses some concepts of magnetohydrodynamics as it applies to magnetically confined fusion. (LSP)

38022 (DOE/ER/53198–146) **An energy confinement study of the MST [Madison Symmetric Torus] reversed field pinch using a Thomson scattering diagnostic.** Den Hartog, D.J. Wisconsin Univ., Madison, WI (USA). Nov 1989. 140p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER53198. Order Number DE90012021. Available from NTIS, PC A07/MF A01; OSTI; INIS; GPO Dep.

Thomson scattering measurements of the central electron temperature and density during the plasma current peak have been performed on the MST Reversed Field Pinch (RFP). This Thomson scattering diagnostic was calibrated for absolute electron density measurements. These measurements of T_e and n_e, when combined with profile assumptions, were used to calculate estimates of energy confinement time (τ_E) and poloidal beta (β_θ). A standard discharge with $I_p \approx 400$ kA, $F \approx -0.1$, and $\theta \approx 1.6$ typically exhibited $T_e \approx 275$ eV, $n_e \approx 2.0 \times 10^{13}$ cm^{-3}, $\tau_E \leq 1$ ms, and $\beta_\theta \leq 8\%$. The results of a limited plasma current scaling study did not indicate a strong scaling of T_e or τ_E with I_p. The Thomson scattering diagnostic was used in conjunction with a bolometer, VUV radiation monitor, and edge magnetic coils to study the loss of energy from the plasma. Results indicate that thermal transport from stochastic magnetic fields, particle loss, and radiation are important energy loss processes. The experiments done for this study included an F-scan, a paddle limiter insertion series, and an argon doping series. The plasma maintained a constant $\beta\tau$ during these perturbation experiments, suggesting that increases in one energy loss channel are compensated by drops in other channels and increases in input power to the plasma.

38023 (DOE/ER/53223–130) **Plasma properties: Annual report, January 1, 1989–December 31, 1989.** Weitzner, H. New York Univ., NY (USA). Magneto-Fluid Dynamics Div. Jun 1990. 35p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER53223. Order Number DE90012865. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper discusses the following topics: MHD plasma activity: equilibrium, stability and transport; statistical analysis; transport studies; edge physics studies; wave propagation analysis; basic plasma physics and fluid dynamics; space plasma; and numerical methods.

38024 (DOE/ER/53301–1) **Joint proposal for US/USSR on nonlinear dynamics and plasma transport: Progress report, September 1989–September 14, 1990.** Maryland Univ., College Park, MD (USA). Lab. for Plasma Research. [1990]. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-89ER53301. Order Number DE90012440. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper discusses the following topics: disrupted surfaces in reversed field pinches; particle transport in tokamaks; Lagrangian particle transport in nonstationary convective patterns; relativistic particle motion in electromagnetic fields; and computer softural. (LSD)

38025 (EP-PMI-RA–1988) **The physics of the ionized media.** Gresillon, D. (Centre National de la Recherche Scientifique (CNRS), 75 - Paris (FR)); Virmont, J. Ecole Polytechnique, 91 - Palaiseau (France). 1988. 42p. (In French). Order Number DE90500841. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the laboratory of the Ionized Media Physics (Polytechnic School, France), is presented. The most important results are obtained on the field of waves: the study of the conversion of a proper mode into another one, by means of the electromagnetic wave scattering. The research program involves the following topics: plasma nonlinear physics, fluctuations and transport phenomena in magnetic fusion plasmas, plasmas and negatif ion beams, beam and plasma radiations, atomic physics and spectroscopic plasma diagnostics, The published papers, the congress communications, the thesis and the patents are listed.

38026 (IPP–6/288) **Self-similar statistics in MHD turbulence.** Camargo, S.J.; Tasso, H. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Feb 1990. 15p. Order Number DE90501227. Available from NTIS (US Sales Only), PC A03/MF A01.

The fully developed turbulence of 3-d resistive, viscous, incompressible magnetohydrodynamics is investigated using Elsasser variables and Hopf equation for probability distributions. The method is an extension of a previous work for Navier Stokes equations based on a suggestion by Hopf. It uses essentially self-similar properties of the statistics, which 'almost' determine the turbulence spectrum up to a mild assumption on an unknown function. This spectrum is the well known Kolmogorov spectrum. (orig.).

38027 (IPP–6/290) **Generalized Cherry oscillators and negative energy waves.** Pfirsch, D. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Feb 1990. 5p. Order Number DE90501229. Available from NTIS (US Sales Only), PC A02/MF A01.

In 1925 Cherry discussed two oscillators of positive and negative energy that are nonlinearly coupled in a special way, and presented exact solutions of the nonlinear equations showing explosive instabilities independent of the strength of the nonlinearity and the initial amplitudes. In this paper Cherry's Hamiltonian is transformed into a form which allows a simple physical interpretation. The new Hamiltonian is generalized to three nonlinearly coupled oscillators; it corresponds to three-wave interaction in a continuum theory, like the Vlasov-Maxwell theory, if there exist linear negative energy waves. (orig.).

38028 (IPP–6/291) **On the roles of the density and temperature gradients in the theory of nonlinear drift waves.** Salat, A.

Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.). Feb 1990. 15p. Order Number DE90501239. Available from NTIS (US Sales Only), PC A03/MF A01.

It was recently claimed that in nonlinear coherent drift wave theory the temperature gradient κ_T=d lnT/dx is irrelevant and that, instead of κ_T, the derivative $d\kappa_n/dx$ of the density gradient κ_n=d lnn/dx (with a factor T/u) determines the nonlinearity. It is shown that this claim is erroneous in general and is caused by neglecting the space dependence of the phase velocity $u(x) \simeq -\kappa_n T$ of the waves. The inhomogeneity of the refractive index for drift waves is approximately $\propto du/dx \propto \kappa_T - (d\kappa_n/dx)T/u$. The case $\kappa_n(x)T(x) = const$, therefore, is special in two respects: the plasma does appear homogeneous to the waves, but also the disparate nonlinear terms coincide. In the generic case, however, n(x) and T(x) are independent profiles, and the temperature gradient nonlinearity is responsible for quasi-one-dimensional soliton-like waves. Their duration, however, is limited by the inhomogeneity of the refractive index. (orig.).

38029 (JAERI-M–89-226) **Electron temperature profile measurement using the filter absorption method in JT-60.** Nagashima, Keisuke (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Nishitani, Takeo; Takeuchi, Hiroshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1990. 26p. Order Number DE90798729. Available from NTIS (US Sales Only), PC A03/MF A01.

The electron temperature profile was measured in JT-60 from the two arrays of 16 channel PIN photo-diodes arranged in parallel using the filter absorption method. From the error estimation of this method, especially for the impurity line radiation, the error was considered to be 10-20%. These values were confirmed by the comparison with the other measurements and this method was confirmed to be useful as the measurement of the electron temperature profile except for the very low density discharge below 1.5×10^{19} m^{-3} line averaged electron density. (author).

38030 (JAERI-M–90-005) **Test on fast data transfer between a VME-bus system and a CAMAC system.** Kawamata, Youichi (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Kurihara, Kenichi; Kimura, Toyoaki; Takahashi, Minoru. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1990. 33p. (In Japanese). Order Number DE90798730. Available from NTIS (US Sales Only), PC A03/MF A01.

Test results are reported on data transfer between a VME-bus system and a CAMAC system. To improve the computation capability in the JT-60 upgrade plasma control from the view points of speed and accuracy, the VME-bus system, where 32-bit floating calculation can be executed by a 20MHz or faster-cycle CPU, is installed in the present feedback control system based on CAMAC interfaces. As a result, the time required for the data input and output can be extremely reduced in the new system, which makes it possible to suppress the crucial vertical instability of elongated plasmas in the JT-60 upgrade. (author).

38031 (ORNL/FTR–3624) **[Atomic and molecular data for metallic impurities in fusion plasmas]: Foreign trip report, May 15–21, 1990.** Gregory, D.C. Oak Ridge National Lab., TN (USA). 7 Jun 1990. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012213. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Representatives from electron-impact and ion-atom research groups reviewed and rated the available data on collision processes, of interest to fusion, involving impurity metals. The best available data were identified and rated for accuracy. Gaps and needs for additional experiments and calculations were noted. Summary articles with the group conclusions and recommendations will be published in a special topical issue of Physica Scripta along with articles on specific related topics by members of the Advisory Group. Laboratories at University College, London, were visited in order to renew contact with the research group there, which is one of the three most active in the United Kingdom in electron collision experiments.

38032 (PPPL–2697) **Error analysis of a new asymmetric Abel-inversion method.** Park, Hyeon K. Princeton Univ., NJ (USA). Plasma Physics Lab. Jun 1990. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE90011264. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Propagation of the various errors in a new asymmetric Abel-inversion method is investigated. In order to provide a meaningful error analysis of the inversion process, both the effects of geometrical factors and measuremental errors are studied. The dominant source of uncertainty in the determination of local electron density is due to the spline fitting of the interferometric measurements with uneven spacings. The propagation of these errors is highly spatially localized and heavily damped in this inversion method. The absolute range of error in the local electron density is $\pm 1.5 \times 10^{12}$ cm^{-3}. 4 refs., 3 figs.

38033 (PPPL–2699) **Neutral beam emission spectroscopy diagnostic for measurement of density fluctuations on the TFTR tokamak.** Paul, S.F. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Fonck, R.J. Princeton Univ., NJ (USA). Plasma Physics Lab. Jun 1990. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE90011263. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A multi-channel diagnostic for measuring low amplitude, long wavelength ($k_{\perp \rho_i} < 0.5$) density fluctuations along the outer half of the plasma has been installed on TFTR. It is based on observing fluctuations in the H_α fluorescence of a neutral heating beam due to collisional excitation from the plasma and impurity ions. Both radial and poloidal correlation lengths as short as 2–3 cm can be determined, with the spatial resolution limited primarily by the width and geometry of the three neutral beam sources. Optical fibers transmit the light from a 20-cm diameter vacuum window, reentrant mirror, and lens assembly to sixteen interference filter/photomultiplier combinations located outside the radiation area. Initially, the fibers comprise a fixed 55-channel radial array and readily movable 10-channel vertical arrays which can be positioned at 27 radial locations. The filters are designed to accept the Doppler-shifted H_α emission from primary energy component of the neutral beam, and reject background lines and unshifted edge H_α. The measurable fluctuation amplitude (@ S/N = 1) is limited to 0.5% over a 100 kHz bandwidth by the photon noise associated with the DC level of the beam emission. The contribution of impurities to the total beam fluorescence will be determined directly by measuring impurity density fluctuations using charge exchange recombination emission from the n = 8 – 7 CVI line at 5292 Å. 6 refs., 2 figs., 2 tabs.

38034 (PPPL–2700) **Measurements of radial profiles of He^{2+} transport coefficients on TFTR [Tokamak Fusion Test Reactor].** Synakowski, E.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Stratton, B.C.; Efthimion, P.C.; Hulse, R.A.; Johnson, D.W.; Mansfield, D.K.; Park, H.; Scott, S.D.; Taylor, G.; Fonck, R.J. Princeton Univ., NJ (USA). Plasma Physics Lab. Jun 1990. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE90012018. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Measurements of the spatial structure of the transport coefficients of He^{2+} on the Tokamak Fusion Test Reactor is reported. He^{2+} profiles were measured using charge exchange spectroscopy after a helium puff into corotating L-mode plasmas. Modelling shows that the He^{2+} diffusivity is about 10 m^2/s near the plasma edge and drops to below 1 m^2/s inside of the q = 1 surface. The convective velocity ranges from 1–3 m/s near q = 1 to 20–40 m/s near the edge. The helium diffusivity is on the order of the ion momentum and thermal diffusivity and is greater that than the electron thermal diffusivity. 4 refs., 4 figs.

38035 (PPPL–2703) **Influence of MHD effects and edge conditions on ITER helium ash accumulation and sustained ignition.** Redi, M.H.; Cohen, S.A. Princeton Univ., NJ (USA). Plasma Physics Lab. Jun 1990. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE90012017. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Dilution of reacting species by build-up of helium ash and its effect on ignition in the ITER tokamak have been studies in a series

of simulations with the one-dimensional BALDUR transport code. Thermal diffusivities, obtained from ITER scaling laws and with radial variations observed in JET, gave $\tau_E \approx 2$–4 sec. Refueling of deuterium and tritium maintained constant electron density, while carbon recycling was 100% and the helium ash recycling was varied from 1.0 to 0.5. Including MHD effects, specifically sawteeth and beta limits, we find that ignition can be sustained for 200 seconds with $R_{helium} = 0.95$. These simulations, the only non-zero-dimensional, time-dependent simulations thus far made for ITER plasmas, emphasize that edge plasma conditions, MHD behavior, and helium particle transport are critical synergistic issues for sustained ignition. 27 refs., 2 figs., 1 tab.

38036 (PPPL–2707) **Measurement of iron transport in TFTR [Tokamak Fusion Test Reactor] by charge exchange recombination spectroscopy.** Stratton, B.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Synakowski, E.J.; Efthimion, P.C.; Hill, K.W.; Hulse, R.A.; Johnson, D.W.; Park, H.; Taylor, G.; Timberlake, J.; Fonck, R.J. Princeton Univ., NJ (USA). Plasma Physics Lab. Jun 1990. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE90013500. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Transport of iron in TFTR discharges is studied by spatially-resolved charge exchange recombination spectroscopy in the visible region of the spectrum. Time evolutions of the densities of Fe^{24+} and Fe^{23+} ions following injection of iron are modeled by the neoclassical flux plus a moderately hollow diffusivity increasing linearly from 1.3 m^2/sec on axis to 2.4 m^2/sec at the plasma edge. For r/a>0.5. the iron diffusivity is significantly smaller than the helium diffusivity measured in identical discharges, while it is larger in the region immediately surrounding the plasma axis. 15 refs., 3 figs.

38037 (PSC–1) **Electron motion in a nonlinear magnetosonic wave propagating perpendicularly to a magnetic field.** Ohsawa, Yukiharu. Nagoya Univ. (Japan). Plasma Science Center. Oct 1989. 29p. Order Number DE90798728. Available from NTIS (US Sales Only), PC A03/MF A01.

Electron motion is studied analytically and numerically. In the framework of the drift approximation, the electron motion is given by the sum of the ExB- and ∇B- drifts. The ∇B drift is anti-parallel to the E_xxB drift (E_x is the longitudinal electric field). For a strong magnetic field, the E_yxB drift dominates in the shock region. Full electron dynamics is then numerically studied, and basic patterns of electron motion is presented. For a rather strong magnetic field (ω_{ce} > or approx. ω_{pe}), the E_yxB-drift speed can be close to the speed of light, and relativistic effects become important. Energies of energetic electrons are found to oscillate with amplitudes of the order of the electron rest mass energy. A qualitative explanation is given for the relativistic energy oscillation. (author).

38038 (PSC–5) **New non-axisymmetric eigenmodes associated with an edge plasma layer.** Yamanaka, Kaoru (University of Industrial Technology, Sagamihara, Kanagawa (Japan)); Sugihara, Ryo. Nagoya Univ. (Japan). Plasma Science Center. Dec 1989. 24p. Order Number DE90798727. Available from NTIS (US Sales Only), PC A03/MF A01.

Effects of a rarefied plasma layer surrounding a cylindrical main plasma on Alfven waves are investigated. The plasma is approximated with a two-step density profile and is assumed to be surrounded with a conducting wall. When the Alfven resonance exists inside the rarefied plasma layer, two new modes are generated. One has its maximum of the wave intensity at the wall, is thus similar to a surface wave and the other is a short of a coaxial mode. These results are re-examined in a diffuse boundary plasma and the presence of these modes is confirmed. (author).

38039 (RAL–90-008) **Large amplitude waves and fields in plasmas.** Angelis, U. de (Rutherford Appleton Lab., Chilton (UK)). Rutherford Appleton Lab., Chilton (UK). Feb 1990. 28p. (CONF-8911198–: Workshop on laser-plasma interaction, Indore (India), 30 Nov 1989). Order Number DE90630699. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

In this review, based mostly on the results of the recent workshop on "Large Amplitude Waves and Fields in Plasmas" held at ICTP (Trieste, Italy) in May 1989 during the Spring College on Plasma Physics, I will mostly concentrate on underdense, cold, homogeneous plasmas, discussing some of the alternative (to fusion) uses of laser-plasma interaction. In Part I an outline of some basic non-linear processes is given, together with some recent experimental results. The processes are chosen because of their relevance to the applications or because new interesting developments have been reported at the ICTP workshop (or both). In Part II the excitation mechanisms and uses of large amplitude plasma waves are presented: these include phase-conjugation in plasmas, plasma based accelerators (beat-wave, plasma wake-field and laser wake-field), plasma lenses and plasma wigglers for Free Electron Lasers. (author).

38040 (SAND–89-2775C) **New diagnostic developments for intense ion beam measurements on PBFA-2.** Leeper, R.J.; Stygar, W.A.; Maenchen, J.; Bailey, J.E.; Baldwin, G.T.; Bloomquist, D.D.; Carlson, A.L.; Chandler, G.; Cooper, G.; Derzon, M.S. Sandia National Labs., Albuquerque, NM (USA). [1990]. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9007111–3: 8. international conference on high-power particle beams, Novosibirsk (USSR), 2-5 Jul 1990). Order Number DE90013497. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A news diagnostic package has been developed for the Sandia National Laboratories' PBFA-II accelerator. The package — which emphasizes off-axis Rutherford-scattering measurements — includes the following: off- and on-axis multi-frame dE/dx ion pinhole cameras, an off-axis energy-resolved ion movie camera, an on-axis time-resolved ion movie camera, an off- or on-axis time-resolved Rutherford magnetic spectrograph which has a one-dimensional imaging capability, time-integrated and time-resolved Kα x-ray pinhole cameras, a plasma visible spectroscopy diagnostic, an elliptical crystal spectrograph, and a high bandwidth transient data recording system based on fiber-optic and streak camera technology. Additionally, several other new diagnostic systems are currently under development. These consist of an ultra-fast x-ray framing camera based on sealed MCP imaging tubes, a time-resolved Kα x-ray pinhole camera that has a film/scintillator image plane coupled to a 14 x 18 element array of 100-μm-diameter fiber optics, a large-radius Rutherford beam diagnostic, a proposed flash radiography system, and a Doppler neutron time-of-flight diagnostic. 12 refs., 4 figs.

38041 (TRITA-PFU–89-01) **Experimental studies of equilibrium in the toroidal Extrap T1 experiment.** Drake, J.R.; Hedin, E.R.; Karlsson, P.; Jin Li; Saetherblom, H.E. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. Mar 1989. 24p. Order Number DE90630691. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Experimental studies of a toroidal, high-beta plasma discharge with a non-circular cross-section are described. In Extrap T1, four toroidal, current-carrying rings outside the plasma discharge current channel produce a separatrix which bounds the plasma. Plasma currents of up to 40 kA are induced, operating with a toroidal field of up to 0.2 T. The major radius of the device is 0.45 m and the average minor radius of the current channel is about 40 mm. The discharge pulse is approximately 100 μsec long. For the discharges reported here, the peak current density on the discharge axis is about 9 MA/m^2, which corresponds to an on-axis safety factor q_o of about 0.1. The plasma density is in the range $n \simeq 0.2$ to 1 x 10^{21} m^{-3}, and the electron temperature is in the range $T_e \simeq 10$ to 30 eV. Magnetic flux plots of the experiment have been studied using magnetic probes and current and pressure profiles have been derived from the magnetic data.

38042 (TRITA-PFU–89-02) **Poloidal rotation asymmetry and electric field effects at the edge of a divertor TOKAMAK.** Tendler, M.; Rozhansky, V. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. Oct 1989. 18p. Order Number DE90630692. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The transport of plasmas in the vicinity of the separatrix is investigated. An analysis of the drift fluxes resulting from the radial and poloidal electric fields is presented. The velocity of the poloidal rotation arising due to the radial field is calculated for a given temperature profile near the separatrix. Steeper temperature profiles in

the vicinity of the separatrix lead to a significant increase of the rotation velocity. The rotation affects the power flow asymmetry and the nonambipolar current in the scrape-off layer of a divertor tokamak. Novel methods to affect the plasma exhaust and thereby to improve the overall confinement are emphasized.

38043 (TRITA-PFU-89-03) **Extrap interchange stability.** Scheffel, J. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. May 1989. 31p. Order Number DE90630703. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

This is a non-linear MHD study of Extrap interchange stability. The closed-line stability criterion $d(pg\gamma)/d\psi \geq 0$ is used for fully 2-D numerical calculations of marginally stable equilibria. It is found that Extrap has a stabilzing effect on these modes. The reason for this is that $q = Id\ell/B$ diverges towards the separatrix, which forms a boundary for the pinch. Consequently, in comparison with the 1-D Z-pinch, the Extrap octupole field allows steeper pressure profile in the boundary region. This stabilizing effect is shown to diminish in equilibria with an externally imposed axial magnetic field. It is also shown how the shape of the plasma cross-section depends on the relative direction of plasma current and external rod currents, when the current density j is finite on the boundary. Unfavourable curvature and higher values of j at the boundary are obtained in the case of parallel currents. Only when j vanishes at the separatrix, the cross-section can be truly square-shaped. The type of singularity of q at the separatrix is derived, as well as criteria for j to become singular.

38044 (TRITA-PFU-89-04) **Ion heat conduction losses in Extrap.** Tennfors, E. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. Aug 1989. 16p. Order Number DE90630693. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The classical ion heat conduction losses in Extrap discharges are calculated using polynomial magnetic field profiles and compared to the power input. For polynomials matched to magnetic field profiles measured in present experiments, these losses are small. By varying the coefficients of the polynomials, a region is found, where the power input can balance the classical heat conduction losses. Each set of coefficients corresponds to values of the parameters F and Θ used in RFP physics. The region determines a region in an F-Θ diagram, including the usual RFP region but extending to higher values of Θ and $\beta\Theta$.

38045 (TRITA-PFU-89-05) **Plasma position from ring current measurements in Extrap T1.** Brunsell, P.; Jin Li. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. Nov 1989. 34p. Order Number DE90630704. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The inductive coupling between the plasma and the four octupole field coils in the Extrap T1 device is utilized as a means of estimating the plasma position. The current in each octupole ring as well as the plasma current is measured by a Rogowski coil and the ring - plasma mutual inductance is then computed assuming axisymmetric plasma displacements. The obtained position is in agreement with internal magnetic probe measurements. The time - evolution of the plasma position for different external vertical and toroidal field strengths is studied. For the present discharge parameter a vertical field of about .008 T is found to give an almost radially stationary plasma. The results are compared with a simple equilibrium model.

38046 (TRITA-PFU-89-06) **Thomson scattering measurements on the high beta pinch Extrap-T1.** Karlsson, P. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. Nov 1989. 21p. Order Number DE90630696. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Electron temperature and density measurement on a high beta discharge in the Extrap-T1 device have been performed with Thomson scattering. It was found that the signal levels were low and the plasma background radiation high. The spread of the measured temperatures and densities was large. A computer code was developed to investigate whether this spread in measured temperatures was due to shot to shot variations or to photon statistics. The code showed that the scattered data could be explained by photon statistics.

38047 (TRITA-PFU-89-07) **The effect of the radial electric field on the L-H mode transition in Tokamaks.** Rozhansky, V.; Tendler, M. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. Oct 1989. 25p. Order Number DE90630694. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A novel solution for the radial electric field profile in a tokamak is found taking account of the effect of the spatial inertia. This effect results due to the anomalous particle transport and the inhomogeneity of the radial electric field. The solution emerges when there is a significant population of banana particles in the inner core up to a separatrix and a sufficiently large anomalous loss. The criteria to ensure this solution are derived. If these constraints are not fulfilled, the poloidal rotation velocity profile is predicted to agree with the neoclassical theory. The existence of the solution crucially depends on the boundary conditions imposed on the value of the poloidal rotation velocity at the inside of the separatrix. These boundary conditions are governed by the effect of the poloidal rotation both in the scrape-off layer (SOL), discussed in the adjacent publication, and the collisionless layer, arising due to the rotational discontinuity. The catastrophe type transition, termed 'the inertial catastrophe', between two solutions has been demonstrated from this model. The characteristic feature of this transition is the drastic growth of the poloidal rotation, which corresponds to the inward direction of the sustaining radial electric field. Since changes of the electric field just inside the separatrix are believed to play the important role in obtaining the improved confinement, the mechanism arises capable of providing a sharp transition to the novel regime of confinement. This newly discovered regime seems to contain many features typical for the H-mode.

38048 (TRITA-PFU-89-08) **Impurity behaviour in the EXTRAP-T1 pinch experiment studied by VUV spectroscopy.** Brzozowski, J.H. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion (Research)). Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. Nov 1989. 31p. Order Number DE90630697. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

Vacuum ultraviolet observations from a low-q, high-beta pinch plasma (Extrap-T1) are presented and related to other plasma parameters. Qualitative analysis of the line emission from low ionization stages of carbon and oxygen, which dominate this spectrum, gives information on the ionization stages reach a steady state during the equilibrium phase of the discharge, and that line radiation does not dominate the power balance. The energy balance of the plasma discharge is analysed from the vacuum ultraviolet line and continuum spectroscopy data. Furthermore it is found, that the time behaviour of the plasma resistance can be understood using the results from the spectroscopic observations. (authors).

38049 (TRITA-PFU-89-09) **Upper pinch radius limit in EXTRAP.** Lehnert, B. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. Dec 1989. 20p. Order Number DE90630705. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A simple static equilibrium model of the Z-pinch is considered where a hot plasma core is surrounded by a cold-mantle (gas blanket). The pinch radius, defined as the radial extension of the fully ionized plasma core, is uniquely determined by the plasma particle. momentum and heat balance equations. In Extrap configurations an octupole field is introduced which imposes a magnetic separatrix on Z-pinch geometry. This makes the conditions for Extrap equilibrium 'overdetermined' when the characteristic pinch radium given by the plasma parameters tends to exceed the characteristic radius of the magnetic separatrix. In this case no conventional pinch equilibrium can exist, and part of the current which is forced into the plasma discharge by external sources must be channelled outside of the separatrix, i.e. into the surrounding support structure of the Extrap conductors and the vessel walls. A possibly existing bootstrap current in the plasma boundary layer is further expected to be 'scraped off' in this case. The present paper gives some illustrations of the marginal case of this upper pinch radius limit, in a

state where the pinch current is antiparallel to the external rod currents which generate the octupole field. (authors).

38050 (TRITA-PFU–89-10) **Lower pinch radius limit in EXTRAP.** Lehnert, B. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. 11 Dec 1989. 14p. Order Number DE90630706. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

In an Extrap pinch there is a superimposed magnetic octupole field which forms a magnetic separatrix with the field generated by the pinch current. Earlier experiments have shown that the octupole field has a stabilizing influence on the plasma. Regardless of the details of this stabilizing mechanism, it is expected that the influence of the octupole field should become negligible for a sufficiently small ratio between the characteristic pinch and separatrix radii. In other words, there should exist a lower limit of this ratio below which the system approaches the state of an ordinary unstabilized Z-pinch. The present paper presents an extended version of an earlier theoretical model of this lower limit, and its relation to the corresponding critical ratio between the external conductor and pinch currents. This ratio is found to vary substantially with the plasma parameters. (authors).

38051 (TRITA-PFU–90-01) **Diffusion-driven currents in a Z-pinch.** Lehnert, B. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research. Feb 1990. 25p. Order Number DE90630700. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

A model of a Z-pinch and related systems such as Extrap is considered where there is a hot fully ionized plasma core which is impermeable to neutral gas and being surrounded by a partially ionized cool boundary layer. The pinch is driven by an imposed toroidal (axial) electric field. The model should apply both to linear geometry at sufficiently long axial lengths and to toroidal geometry at large aspect ratios. The recirculation of matter in the boundary layer generates diffusion-driven 'bootstrap-like' currents, both in the toroidal and the poloidal (transverse) directions. The largest toroidal bootstrap currents arise at relatively low plasma densities, high temperatures of the core edge and weak toroidal magnetic fields. There is a low-density limit at which the core becomes 'permeable' to neutral gas and where the bootstrap currents and plasma-neutral gas interaction are distributed all over the plasma body. The toroidal bootstrap current reinforces the externally driven pinch current, and the poloidal bootstrap current produces a diamagnetic effect. The diffusion-driven current system is expected to become disturbed when the pinch radius approaches its upper limit, as defined by a magnetic separatrix or a metal limiter.

38052 (UCRL–102939-Rev.1) **Start-effect measurement of high FEL [free-electron laser] electric fields in MTX [Microwave Tokamak Experiment] by laser-aided particle-probe spectroscopy.** Oda, T. (Hiroshima Univ. (Japan)); Takiyama, K.; Odajima, K.; Ohasa, K.; Shiho, M.; Mizuno, K.; Foote, J.H.; Nilson, D.G. Lawrence Livermore National Lab., CA (USA). 10 May 1990. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-900557–5: 8. topical conference on high-temperature plasma diagnostics, Hyannis, MA (USA), 6-10 May 1990). Order Number DE90013474. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We are constructing a diagnostic system to measure the electric field (>100 kV/cm) of a free-electron laser (FEL) beam when injected into the plasma of the Microwave Tokamak Experiment (MTX). The apparatus allows a crossed-beam measurement, with 2-cm spatial resolution in the plasma, involving the FEL beam (with 140-GHz, ≈1-GW ECH pulses), a neutral-helium beam, and a dye-laser beam. After the laser beam pumps metastable helium atoms to higher excited states, their decay light is detected by an efficient optical system. Because of the Stark effect arising from the FEL electric field ($\vec{E}$), a forbidden transition can be strongly induced. The intensity of emitted light resulting from the forbidden transition is proportional to E^2. Because photon counting rates are estimated to be low, extra effort is made to minimize background and noise levels. It is possible that the lower $\vec{E}$ of an MTX gyrotron-produced ECH beam with its longer-duration pulses can also be measured using this method. Other applications of the apparatus described here may include measurements of ion temperature (using charge-exchange recombination), edge-density fluctuations, and core impurity concentrations.

38053 (UCRL-JC–103311-Rev.1) **MTX [Microwave Tokamak Experiment] data acquisition and analysis computer network: Revision 1.** Butner, D.N.; Casper, T.A.; Brown, M.D.; Drlik, M.; Meyer, W.H.; Moller, J.M. Lawrence Livermore National Lab., CA (USA). Jun 1990. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-900557–12: 8. topical conference on high-temperature plasma diagnostics, Hyannis, MA (USA), 6-10 May 1990). Order Number DE90013066. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

For the MTX experiment, we use a network of computers for plasma diagnostic data acquisition and analysis. This multivendor network employs VMS, UNIX, and BASIC based computers connected in a local area Ethernet network. Some of the data is acquired directly into a VAX/VMS computer cluster over a fiber-optic serial CAMAC highway. Several HP-Unix workstations and HP-BASIC instrument control computers acquire and analyze data for the more data intensive or specialized diagnostics. The VAX/VMS system is used for global analysis of the data and serves as the central data archiving and retrieval manager. Shot synchronization and control of data flow are implemented by task-to-task message passing using our interprocess communication system. The system has been in operation during our initial MTX tokamak and FEL experiments; it has operated reliably with data rates typically in the range of 5 megabytes/shot without limiting the experimental shot rate.

38054 Effects of higher-order dispersion on envelope solitons. Kuehl, H.H. (University of Southern California, Los Angeles, CA (USA)); Zhang, C.Y. pp. 47-48 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). Grant ECS-8608281. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The use of a direct perturbation theory in which u is expanded in powers of the perturbation parameter ε, yields the following soliton modifications through order ε: the soliton retains its hyperbolic secant shape, but its velocity is increased and it experiences a negative wavenumber shift. No radiation is predicted by this direct perturbation theory. However, numerical integration shows that the soliton does radiate.

38055 Filamentation instability of MHD waves in solar wind plasma. Kuo, S.P. (Polytechnic Univ., Farmingdale, NY (USA). Weber Research Inst.); Whang, M.H. pp. 96 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). Grant AFOSR-88-0127. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The ISEE 1 and 2 spacecrafts have detected both magnetosonic waves and Alfven waves propagating upstream in the high-speed solar wind. The stability of such waves has drawn a considerable attention in recent years. Various processes of parametric and modulation instabilities excited by the Alfven pumps have been investigated. Moreover, the filamentation instability which can break up the large-amplitude Alfven waves and induce not only plasma density fluctuations but also magnetostatic fluctuations has also been investigated.

38056 Studies of injected particle trajectories in the beat wave accelerator. Williams, R. (California Univ., Los Angeles, CA (USA). Dept. of Physics); Mori, W.B.; Clayton, C.E.; Joshi, C.; Leemans, W.; Marsh, K.; Katsouleas, T. pp. 57 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The trajectories of relativistic electrons (γ = 4), injected into the potentials of 3-D relativistic plasma waves (γ_{ph} = 13.5), have been calculated using Monte Carlo simulation techniques in order to

quantitatively predict the output of the laser plasma beatwave acceleration experiments at UCLA. These calculations have permitted the analysis of accelerated (and decelerated) electrons according to the quantity of electrons accelerated, the angular distribution and the energy spectrum. These calculations have also guided the modification of the electron detection system in order to optimize electron transport and maximize detection efficiency. The electron transport system consists of a long solenoid and a magnetic spectrometer and the electron detection system consists of an array of silicon surface barrier detectors.

38057 **Ion acoustic decay instabilities in laser pellet interactions.** Mizuno, K. (Plasma Physics Research Institute (US)); De Groot, J.S.; Kawata, S.; Young, P.E.; Drake, R.P.; Estabrook, K.G.; Seka, W.; Bahr, R. pp. 85-86 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Microwave experiments, and computer simulations have shown that the Ion Acoustic parametric Decay Instability (IADI) can produce a significant number of hot electron in a large scale plasma. These hot electrons are a concern in proposed inertial confinement fusion (ICF) studies because they can preheat the target and degrade compression. The ion wave turbulence excited by IADI will also be the source of anomalous resistivity, sot that the thermal electrons are strongly heated due to anomalous Joule heating. The authors have extensively studied the IADI in laser-pellet interactions. The authors have shown that the IADI threshold is quite low, so that IADI is potentially important in laser drive fusion pellets. The authors have shown that the ionic charge state Z can be measured using the Stokes signal. Thus IADI is also a useful tool for plasma diagnostics at the critical surface.

38058 **Generalized Langevin equation for plasma turbulence.** Xia, H. (Texas Tech Univ., Lubbock, TX (USA). Dept. of Electrical Engineering); Ishihara, O. pp. 47 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). Grant 86-0156. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The generalized Langevin equation, originally derived for the study of Brownian motion by Mori and Kubo, has been applied to the study of plasma turbulence. The evolution equation for the particle velocity in an electrostatic plasma turbulence is derived by the projection operator method. The time integral appearing in the equation indicates that the wave-particle interaction in a plasma is not a Markovian process. Thus the wave-particle interaction cannot be described as instantaneous collisions between particles and wave quanta (quasi-particles) as is usually done in a conventional weak turbulence theory.

38059 **Turbulence studies of high pressure dynamic nitrogen arcs.** Sen, U. (Spectronics Corp., Westbury, NY (US)); Benenson, D.M. pp. 65 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). Grant CPE 8007187. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The main current pulse was a half sinusoid of 1.4kA peak value, having a nominal slope of $\simeq -17A/\mu s$ into current zero. A high speed optical system was employed to scan the cross section of the radiating arc column at different axial positions. Optical data were acquired at various times during the main current pulse, through the appropriate use of electro-optical timing circuits.

38060 **Plasma motion into a transverse magnetic field and plasma.** Wessel, F.J. (California Univ., Irvine, CA (USA). Dept. of Physics); Fisher, A.; Rostoker, N.; Song, J. pp. 87 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

In spite of its fundamental significance for plasma physics the diffusion of a plasma beam into a transverse magnetic field and magnetized plasma is an unsolved problem. Major issues which remain include rapid diffusion of the magnetic field in vacuum and in the presence of a background plasma. In a transverse magnetic field a tenuous beam follows a curved Lorentzian trajectory.

38061 **The electron energy distribution function of noble gases with flow.** Karditsas, P.J. (Maryland Univ., College Park, MD (USA). Dept. of Mechanical Engineering). pp. 77 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The treatment of the Boltzmann equation by several investigators, for the determination of the electron energy distribution function (EEDF) in noble gases was restricted to static discharges. It is of great interest to magnetoplasmadynamic power generation to develop the Boltzmann equation to account for the effect of the bulk fluid flow on the EEDF. The two term expansion of the Boltzmann equation, as given, results in additional terms introduced to the equations due to the bulk fluid flow, with velocity **u**.

38062 **The role of stellarators in understanding toroidal transport physics.** Rasmussen, D.A. (Oak Ridge National Lab., TN (USA)); Bigelow, T.S.; Carreras, B.A.; Colchin, R.J.; Crume, E.C.; Anderson, F.S.B.; Bell, G.L.; Bell, J.D.; Bengtson, R.D.; Carter, K.R. pp. 59-60 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). DOE Contract AC05-84OR21400. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Grater importance is now being attached to understanding transport physics in toroidal confinement devices. Stellarators and tokamaks share many transport issues (anomalous χ_e, confinement deterioration with heating power, etc.), but they also have fundamental differences. The similarities and differences can be exploited in order to better understand the underlying physics of transport. Stellarators and tokamaks both rely on nested toroidal flux surfaces formed by helical magnetic fields for confinement.

38063 **Confinement dynamics in the ZT-40M RFP.** Weber, P.G. (Los Alamos National Lab., NM (USA)); Ingraham, J.C.; Miller, G.; Munson, C.P.; Phillips, J.A.; Pickrell, M.M.; Schoenberg, K.F.; Wurden, G.A. pp. 79 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Typically one-third of the input power is accounted for by radiation as measured by bolometers. This radiated power fraction has been varied from 0.15 to 0.95 in impurity injection experiments, with the global β and τ_E values maintained to within a factor two. This implies that the non-radiative confinement varied by a factor five or more while the total confinement remained roughly the same.

38064 **The mirrortron ion accelerator concept.** Post, R.F. (Lawrence Livermore National Lab., CA (USA)). pp. 44 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). DOE Contract W-7405-ENG-48. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The Mirrortron accelerator uses transient electric fields developed in a mirror-confined hot electron plasma to accelerate ions. It differs from other collective-effect accelerators in that it may achieve a precision of control of the acceleration and focusing of the accelerated ions comparable to that attained in vacuum field accelerators, while retaining the high gradients and high current capability of plasma-based accelerator concepts.

38065 **A visible plasma.** Alexeff, I. (Univ. of Tennessee, TN (US)); Dyer, F.; Rader, M. pp. 35 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE

Service Center, Piscataway, NJ (USA) (1989). Contract AFOSR-86-0100. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The authors have obtained a steady-state plasma with the plasma frequency in the visible. Thus, in principle, phenomena such as the production of electron plasma oscillations can be observed visually. The plasma frequency is given by $\omega_{pe} = ne^2/\varepsilon_0 m_e^{1/2}$, where ω_{pe} is the plasma frequency (radians/second), e is the electron charge (1.6×10^{-19} coulomb), ε_0 is the permittivity of vacuum (8.85×10^{-12} farad/meter) and m_e is the electron mass ($.91 \times 10^{-30}$ kg).

38066 Resolution requirements for modeling streamer formation in a spark gap. Rodriguez, A.E. (Tetra Corp., Albuquerque, NM (USA)); Touryan, K.J.; Moeny, W.M. pp. 132 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

From Maxwell's equations, the authors derive the charge conservation equation in a general form (neglecting only speed-of-light effects, i.e., retarded potential). That form has powerful implications for the time scale of significant field changes, dependent only on conductivity. From experimental estimates of streamer conductivities and propagation velocities in atmospheric air, the authors infer appropriate temporal and spatial scales to be $\sim$ 0.3 ns and $\sim$ 0.3 cm. Assuming electron impact ionization is the dominant mechanism changing the conductivity so abruptly, using best available rate coefficient data, the authors obtain an estimate of the maximum E-field of $\sim$ 80 kV/cm. These orders of magnitude are relatively insensitive to model details.

38067 Progress in 3D particle-in-cell modeling of heavy ion beam transport in quadrupole focusing channels. Friedman, A. (Lawrence Livermore National Lab., CA (USA)); Mark, J.W.K.; Nielsen, D.E.; Chang, C.L.; Drobot, A.T.; Mankofsky, A. pp. 126 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The authors have also developed a formalism for modeling a bent beam using a time-dependent simulation algorithm which differs only minimally from that used for a straight beam. In this algorithm, particles are advanced as usual, then a transformation made into a rotate locally tangential coordinate system. In a bend, the axial coordinate becomes angle-like: distance along a nominal center-Line. The frame of reference is not accelerating, and no pseudo-forces need be applied. Furthermore, this beam-bending transformation is exact, although it can be made more efficient by approximations suitable to gentle bends. Special residence corrections are needed when a step overlaps the entrance to or exit from a bend; care is also needed when a staggered integrator (such as leapfrog) is employed. The authors are testing this algorithm for future use in full simulations.

38068 Phase-locking of multiple relativistic magnetrons. Levine, J.S. (Physics International Co., San Leandro, CA (USA)); Benford, J.; Cooksey, N.; Harteneck, B.; Smith, R.R.; Sze, H. pp. 122 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The authors examine some issues relevant to arrays of multiple modules. A hierarchy of master and slaves must be established when the communication time within an array becomes comparable to the microwave pulse duration. There are experiments that can be done with a two-magnetron array to gain insight into this issues by establishing a uni-directional link between magnetrons.

38069 Realization of cavity and drift space designs for a 30 MW, 10 GHz gyroklystron. Calame, J. (Maryland Univ., College Park, MD (USA)); Lawson, W.; Latham, P. E.; Miller, S.; Welsh, D.; Skopec, M.; Hogan, B.; Naiman, M.; Carmel, Y.; Granatstein, V.L. pp. 121 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

In this paper the authors present the final preparations for bringing the University of Maryland 10 GHz, 30 MW gyroklystron experiment on-line. The authors summarize the current status of all the major subsystems, which include the modulator, the electron gun, the microwave circuit, the diagnostics, and discuss in detail the realization of the low Q required in the input cavity. Successful operation of device will surpass the state-of-the-art in power capability by three orders of magnitude and will establish the gyroklystron as a primary candidate for driving high-energy linear colliders.

38070 Curve-fitting analysis of time-resolved Thomson spectrograms from a plasma focus. Weidman, D.J. (Advanced Technology and Research, Laurel, MD (US)); Rnee, M.J. pp. 104-105 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

A Thomson spectrometer is a useful diagnostic to measure the energies of protons and helium ions produced by a plasma focus. A time-resolving Thomson spectrometer provides additional information about particle arrival times at the spectrometer. This information can then be analyzed to reveal the nature of ion velocity as a function of time at the location of the ion source. Curves can be fit by the method of least squares to a spectrogram; these curves can be analyzed to provide a continuous plot of the behavior of the ions at the source.

38071 A sixteenth harmonic cusptron oscillator. Tiong, K.K. (Polytechnic Univ., Farmingdale, NY (USA). Weber Research Inst.); Kuo, S.P.; Miller, P.E. pp. 112 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). Grant AFOSR-85-0316. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The cusptron device uses a cusp field to convert an axially moving beam into an axis-encircling electron beam (E-layer) as the radiation source. Such a beam configuration features the strongest finite Larmor radius effect for the harmonic interactions. This device also uses a slotted cylinder waveguide, similar to the anode blocks of a magnetron, to determine the field pattern of the resonant mode. The periodic structure of the waveguide wall introduces periodic fringe fields in the field pattern of the mode, and enriches the resonant harmonic contents of the mode fields for harmonic resonant interaction with electrons. Moreover, such a waveguide structure can allow an efficient operation even at low beam energy and minimize the competition between the modes. Incorporating these features, the cusptron tube is considered to be a promising device for efficient operation at higher cyclotron harmonic modes and accordingly, for keeping the physical size of the device compact.

38072 Characterization of the time-evolution of a microsecond electron beam diode with anode effects. Gilgenbach, R.M. (Intense Energy Beam Interaction Lab., Univ. of Michigan, Ann Arbor, MI (US)); Brake, M.L.; Enloe, C.L.; Miller, J.D.; Repetti, T.E.; Cuneo, M.E. pp. 101 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The time-evolution of a low aspect ratio, microsecond pulse length, electron beam diode with anode plasmas, operating at initial current densities of $\simeq$ 100 A/cm^2, is studied using a variety of experimental and empirical techniques. Of particular interest in this study was the observation of a transition to a roughly constant impedance regime. Results from extensive diode current and voltage modeling, time-resolved spectroscopy (2000–7000 A) of the diode plasma, a time-resolved Cerenkov, beam-profile diagnostic,

Faraday cup measurements, a He-Ne laser deflection diagnostic, and diode RF emission measurements are reported.

38073 Design studies of the 2 mev heavy ion beam probe for text upgrade. Schwelberger, J. (Rensselaer Polytechnic Inst., Troy, NY (USA)); Schoch, P.M.; Hickok, R.L.; Crowley, T.P.; Connor, K.A.; Lewis, J.F. pp. 138 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Based on the trajectory calculations of the 1^+ primary and 2^+ secondary Thallium ion beam at a magnetic field of 2.16 Tesla at the center of the plasma an optimized location of the accelerator, the sweep system and the energy analyzer is found, considering the constraints of coils, ports and size of the room of the TEXT experiment. The energy analyzer must be reasonably far away from the plasma to keep the UV loading in the analyzer vacuum chamber low. Also the sweep system has to be sufficiently far from the plasma to probe the desired portion of the plasma cross section at a feasible sweep angle. The requirements on the sweep system and other system hardware are defined by the given configuration. A detection grid for the optimized system is shown.

38074 Improvements in microchannel plate operating characteristics. Roquemore, A.L. (Princeton Univ., NJ (USA)); Medley, S.S. pp. 139 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Many diagnostics for fusion research utilize micro-channel plate (MCP) detectors for particle and high energy photon detection. Present studies at PPPL have focused on investigation of techniques to overcome two disadvantages of MCP's saturation effects in the count rate at high incident particle/photon fluxes which may be further complicated by the presence of fusion neutron/gamma radiation, and extraneous noise generated by gyroelectrons originating from the negatively biased input surface of the MCP when the detector is operated in an external magnetic field (B = 100 Gauss), which is parallel to the input surface of the plate. The saturation effect for the present set of MCP's occurs for total count rates in the range of 5×10^5 counts/sec/cm^2.

38075 Holographic interferometry of gas-puff Z-pinches. Hsing, W.W. (Sandia National Labs., Albuquerque, NM (USA)); Porter, J.L. pp. 113-114 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). DOE Contract AC04-76DP00789. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The authors have taken image-plane holographic interferograms of a z-pinch implosion on the Supermite accelerator (Z = 2.2 ohms, I = 1.6 MA, t_{pinch} = 80 nsec.) A frequency tripled Nd:Yag laser pulse (FWHM 5 nsec) was beamsplit and delayed to create 2 interferograms 19 nsec apart. The authors have used this diagnostic to observe the imploding sheath and plasma just prior to stagnation. Interferograms were taken of helium, neon and xenon gas puff implosions. The authors have also correlated the regions of density with regions of x-ray emission measured with a time-resolved x-ray pinhole camera.

38076 Soft x-ray spectra of low-Z gases produced by laser irradiation of a high-pressure supersonic gas jet. Filbert, P.C. (Lockheed, Research and Development Div., Palo Alto, CA (US)); Kohler, D.A.; Walton, R.A.; Dahlbacka, G.H. pp. 168 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Soft x-ray spectra from laser-produced carbon, nitrogen, neon, and argon plasmas in the range between 50 and 500 eV are presented. The plasmas were made by irradiating a high-pressure supersonic gas jet with 22-J, 3-ns pulses of 1.054 micron laser light. The laser beam was focussed by a f/4.5 spherical lens into the center of the jet.

38077 Real plasma effects of microwave radiation propagating perpendicular to a magnetized plasma. Jiang, L. (Tennessee Univ., Knoxville, TN (USA). Dept. of Electrical and Computer Engineering); Roth, J.R. pp. 145 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). Contract 86-0100 (Roth). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

New experimental investigations have been undertaken on the attenuation of a microwave beam propagating across a uniform magnetic field with extraordinary and ordinary modes. The experimentally measured level of attenuation, absorption peak half-width, and phase angle are compared with the predictions of the Appleton equation.

38078 Air breakdown in the relativistic limit. Graham, G. (EG and G Energy Measurements, Inc., Los Alamos, NM (USA)); Roussel-Dupre, R. pp. 144-145 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). DOE Contract AC08-88NV10617. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Research into the transmission properties of air to high-power microwave (HPM) radiation involves studies of air breakdown and tail erosion. A fluid model of HPM propagation has been used to study these processes in the atmosphere. Comparisons between the results of this model and those of experiments show good agreement. However, the application of this code is limited to non-relativistic energies and a relativistic code is needed to model higher energies. The relativistic fluid code relflap was developed for the purpose of modeling HPM propagation.

38079 Experimental design of spectroscopic measurements of microwave electric field in MTX tokamak plasma. Mizuno, K. (Plasma Physics Research Institute (US)); Hooper, E.B.; Matsuda, Y.; Oda, T.; Takiyama, K.; Kawasaki, K. pp. 140 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The Microwave Tokamak Experiment (MTX) at LLNL applies an ultra high (peak) power microwave (a few GW) into the Tokamak plasma for current drive, plasma heating, etc. One of the key issues of this MTX project is to understand the ray tracing and power deposition of the ultra high power microwaves in the Tokamak plasma. A new method has been developed to measure the spatially resolved microwave electric field in MTX Tokamak plasma. This method combines laser induced fluorescence spectroscopy with a neutral particle beam (Laser-Aided Particle Probe Spectroscopy). The rf electric field has been previously measured in small laboratory experiments. MTX, however, has much higher density and temperature. One of the most difficult problems is to provide a sufficient density of the radiating atoms in the center of the (burned out) plasma.

38080 Emission spectroscopy of ECRH non-axisymmetric helium mirror plasmas. Junck, K.L. (Plasma Experiment Bay, Univ. of Michigan, Ann Arbor, MI (US)); Brake, M.L.; Getty, W.D. pp. 140-141 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

In this experiment emission spectroscopy in the 3000 to 5000 Angstrom range has been utilized to determine the electron temperature of helium plasmas produced by the Michigan Mirror Machine (MIMI). The plasma is generated and heated by whistler-mode electron-cyclotron resonance waves at 7.43 GHz and 500

Watts power in 400 μs pulses. Gas is puffed into the mid-plane region where a quartz window is used to observe the plasma. The plasma is viewed in a direction perpendicular to the mirror axis.

38081 Magnetic field effects in electrostatic analyzers used for heavy ion beam probe measurements. Zielinski, J.J. (Texas Univ., Austin, TX (USA)); Hallock, G.A. pp. 139 of Interfacial structure, properties and design. IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

If the magnetic field is homogeneous, a completely analytical treatment of the analyzer is possible. The analyzer gain and the location and shape of the secondary beam image on the detector plates can be determined without having to calculate the entire trajectory through the analyzer. If the field is not homogeneous, a numeric calculation of the trajectory is necessary. Results from a trajectory code and the analytical treatment will be presented and compared.

38082 The design of a 400 kV parallel plate electrostatic analyzer for use with the 2 MeV heavy ion beam probe. Resnick, J. (Rensselaer Polytechnic Inst., Troy, NY (USA)); Connor, K.A.; Crowley, T.P.; Hickok, R.L.; Lewis, J.F. pp. 138 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Computer simulation of the analyzer's electric field and equipotential surfaces are being carried out to optimize the design and limit the possibility of field breakdown within the analyzer and between the analyzer and vacuum chamber wall. Models of the current text beam probe analyzer are also being constructed for comparison.

38083 Thermal instability in current-carrying plasmas. Kuo, S.C. (Polytechnic Univ., Farmingdale, NY (USA). Weber Research Inst.); Kuo, S.P. pp. 131-132 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). Grant AFOSR-85-0316. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The effect of temperature gradient on the stability of the discharge has also been examined in our previous work. A modal analysis of the thermal instability shows that a constriction always starts near the electrodes. It is localized there, where the temperature dependence of the thermal and electrical conductivities are assigned parameter values that are characteristic of plasma in MHD channels. In the case of practically fully ionization and very large pressures that prevail in arc-derive railguns, the constriction expands axially over the entire length of the discharge. Consideration in this previous work is restricted to relatively high-pressure situations that the assumption of a single equilibrium temperature among the species of the medium is justified.

38084 Electron swarms in two phase plasmas. McCaughey, M.J. (Illinois Univ., Urbana, IL (USA). Gaseous Electronics Lab.); Kushner, M.J. pp. 130 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

In this paper, the simulation will be described and the effect of particulate matter on the EEDF and electron transport coefficients in partially ionized plasmas will be discussed. The authors find that for typical plasmas (gas pressure 3–10 Torr, electron density 10^9–10^{12} cm^{-3}) particulate densities in excess of 10^4–10^5 are required to significantly perturb the EEDF. In this range, the rate coefficient for electron impact ionization is decreased sufficiently that the self sustaining voltage of a positive column discharge will increase. The local constriction of current by the occluding effects of the sheath is also discussed.

38085 Time resolved plasma characterization in a long conduction time planar plasma opening switch. Adler, L.K. (Cornell Univ., Ithaca, NY (USA). Lab. of Plasma Studies); Greenly, J.B.; Qi, N.; Hammer, D.A. pp. 123-124 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). Contract N00014-85-K-0212. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The authors discuss additional experiments in which the plasma dynamics and properties will be monitored in detail before and during opening. Space and time resolved density, temperature and motion information about the plasma and neutrals is given by emission spectroscopy and streak photography and correlated to the current and voltage traces. Specifically, we will look for the effects of neutrals evolving off of surfaces, stagnation of the switch plasma, and $\vec{J} \times \vec{B}$ motion of the plasma downstream of the switch. Diagnostics include current and voltage monitors, a multi-aperture biased Faraday cup, emission spectroscopy and streak photography. Pairs of $\dot{B}$ dot loops are positioned in the stripline just upstream and downstream of the POS. Also, two single $\dot{B}$ loops were placed further downstream to look for bulk plasma motion. An inductive monitor gives the voltage at the upstream side of the POS and the Faraday cup monitors the gun plasma consistency from shot to shot.

38086 Charge transport dynamics in surface flashover arcs. Kadish, A. (Los Alamos National Lab., NM (USA)); Maier, W.B.; Robiscoe, R.T. pp. 165-166 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Charge transport in a surface flashover arc is analyzed using a transmission line model. The generator is a charge spot whose capacitance is taken to be large compared to the capacitance of the charge path. Resistance per unit length, $\hat{R}$, is assumed to satisfy a local arc welder's ansatz; $\hat{R} \parallel = E^* j$, where I is the local current and E^* is a constant with the dimensions volts per meter.

38087 Radial ion diffusion induced by cyclotron resonance heating at the thermal barrier region in the Phaedrus-B Tandem Mirror. Brouchous, D. (South-western Inst. of Physics, Leshan, Sichuan (CN)); Breun, R.A.; Hershkowitz, N.; Probert, P.; Majeski, R.; Intrator, T.; Roberts, D.; Wen, Y.J.; Ichimura, M. pp. 117-118 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Measurements of radial density profiles using shielded Langmuir probes and radial potential profiles using emissive probes are made at the thermal barrier region. In addition the current to the limiters, the radial current to a collector and the fueling at the thermal barrier region are measured. The density at the plasma edge increased and the potential at the plasma edge decreased as the B field was decreased to bring the resonance into the thermal barrier cell in both a balanced gas puffing and an imbalanced gas puffing case. The data indicated that a possible mechanism is that ions can escape from the confinement region along the open resonance surfaces (the same as the mod-B surfaces) because the turning point of the trapped ions has a tendency to center on mod-B surfaces. An increasing potential observed in the present experiments in the edge region of the plasma, with increasing B field may be related to the higher fluctuation level of radial current to the collector. The effect of resonance condition on plasma behavior at the thermal barrier are investigating in grounded limeter case.

38088 Development of a laser diagnostic system at PBFA II for light-ion-beam research. Perry, F.C. (Sandia National Labs., Albuquerque, NM (USA)). pp. 142 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). DOE Contract AC04-76DP00789. (CONF-8905184–: Institute of Electrical and

Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

A Nd:YAG laser system is under development at the ~ 10' level of PBFA II. Diagnostic applications of the system will include the time and space resolved holographic interferometry of anode and cathode plasmas, as well as plasmas associated with light-ion-driven hydrodynamic targets. A further development may include an x-ray backlighting capability.

38089 Fluctuations and transport due to ion-temperature-gradient-driven instabilities. Sydora, R.D. (Department of Physics, University of California at Los Angeles, Los Angeles, California 90024 (USA)); Hahm, T.S.; Lee, W.W.; Dawson, J.M. *Physical Review Letters (USA),* 64(17): 2015-2018 (23 Apr 1990). DOE Contract FG03-86ER53225 ;AC02-76CH03073.

The nonlinear evolution and spectral properties of ion temperature gradient-driven modes in a three-dimensional sheared magnetic field with multiple rational surfaces have been investigated using gyrokinetic plasma simulation techniques. A detailed study of the electrostatic potential fluctuation spectra shows that it is dominated by the modes with moderate poloidal wavelength ($0.1 \leq k_y \rho_s \leq 0.5$). The measured thermal flux in the steady state, which is lower than the quasilinear value at saturation, is found to decrease weakly with an increase in the magnetic shear strength.

38090 Current drive by spheromak injection into a tokamak. Brown, M.R. (California Institute of Technology, Pasadena, California 91125 (USA)); Bellan, P.M. *Physical Review Letters (USA),* 64(18): 2144-2147 (30 Apr 1990). DOE Contract FG03-86ER53232.

We report the first observation of current drive by injection of a spheromak plasma into a tokamak (Caltech ENCORE small reasearch tokamak) due to the process of helicity injection. After an abrupt 30% increase, the tokamak current decays by a factor of 3 due to plasma cooling caused by the merging of the relatively cold spheromak with the tokamak. The tokamak density profile peaks sharply due to the injected spheromak plasma ($\bar{n}_e$ increases by a factor of 6) then becomes hollow, suggestive of an interchange instability.

38091 Neoclassical transport of toroidal momentum in tokamaks. Ware, A.A. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712 (US)). *Physical Review Letters (USA),* 64(22): 2655-2658 (28 May 1990). DOE Contract FG05-80ET53088.

Allowing for the presence of an expected moderate concentration (~10%) of low-energy ions in excess of the Maxwellian distribution causes a dramatic change in the neoclassical prediction for momentum transport, leading to an agreement in magnitude with experiment.

38092 Nonlinear interaction of intense laser pulses in plasmas. Sprangle, P. (Beam Physics Branch, Plasma Physics Division, Naval Research Laboratory, Washington, D.C. 20375-5000 (USA)); Esarey, E.; Ting, A. *Physical Review, A (General Physics) (USA),* 41(8): 4463-4469 (15 Apr 1990).

A nonlinear one-dimensional theory is developed that describes some important aspects of intense laser-plasma interactions. The self-consistent laser-plasma analysis includes nonlinear plasma wake-field generation, relativistic optical guiding, coherent harmonic radiation production, as well as other related phenomena. Relativistic optical guiding is found to be most effective for long laser pulses having slow rise times. Short laser pulses are shown to be weakly guided. Coherent harmonic generation using a linearly polarized laser is found to be most efficient for short laser pulses and can be enhanced by the presence of large amplitude plasma wake fields. Aspects of particle acceleration by laser pulses as well as possible methods for upshifting the frequency of laser pulses are also discussed.

38093 Ablative Rayleigh-Taylor instability in three dimensions. Dahlburg, J.P. (U.S. Naval Research Laboratory, Washington, D.C. 20375 (US)); Gardner, J.H. *Physical Review, A (General Physics) (USA),* 41(10): 5695-5698 (15 May 1990).

A fully three-dimensional (3D) laser-matter interaction code is developed and used to investigate 3D mixing mechanisms in planar targets accelerated by single-sided laser illumination. While linear Rayleigh-Taylor growth rates from 3D perturbed simulations are identical to those obtained from 2D simulations, nonlinear evolution differs significantly. Vortex stretching alters the ablative flow pattern. Subsequently, the 3D Rayleigh-Taylor spikes are larger in cross section than the 2D spikes, indicating a higher rate of mixing.

38094 A theory of weak transient electrical discharges on dielectric surfaces. Kadish, A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (USA)); Maier, W.B. II; Robiscoe, R.T. *Journal of Applied Physics (USA),* 67(10): 6118-6124 (15 May 1990).

The nonlinear evolution of transient electrical discharges initiated from a small charge spot on dielectric surfaces is analyzed with a transmission line model. The relation between the resistance per unit length, $\hat{R}$, and the current, I, is assumed to be given by a local Arc Welder's Ansatz: $\hat{R}|I|=E^*$, where E^* is a positive constant. Comparison is made with a similar study of discharges initiated from a large charge spot. While both studies predict conditions under which charge is, or is not, transported to a dielectric edge, significant differences in the two cases are revealed. For example, if charge is not transported to an edge, current reversal is possible if the charge spot is small, but can only be unidirectional if the spot is large.

7002 Fusion Power Plant Technology

Refer also to citation(s) 37244, 37304, 37413, 37432, 37503, 37512, 37837, 38013, 38014, 38023, 38025, 38031, 38053, 38056, 38057, 38058, 38059, 38060, 38062, 38063, 38064, 38066, 38067, 38068, 38069, 38070, 38071, 38072, 38073, 38075, 38076, 38077, 38078, 38079, 38081, 38082, 38083, 38084, 38085, 38087, 38088

38095 (CONF-891007--Vol.2, pp. 766-768) **Evaluation of alumina dispersion strengthened (ODS) copper for possible use in the central solenoid and TF coils for the compact ignition tokamak (CIT).** Vieira, R. (Massachusetts Institute of Technology, Cambridge (USA)); Feng, J.; Thome, R.J.; Pelloux, R.M.; Bushnell, C.W. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The tensile, fatigue and electrical characteristics of small samples of ODS copper, indicate that it is an attractive candidate for the conductor in the Central Solenoid and TF coils in the Compact Ignition Tokamak (CIT). It will, however, be necessary to obtain the material in substantially larger sizes than previously produced. The central solenoid requires plates which are about 1900 x 1900 x 22 mm (75 x 75 x 0.875 inches) in size and the TF coils would need plates which are about 1200 x 5300 x 22 mm (46 x 210 x 0.875 inches). This paper describes the status and results from R and D tasks which are underway to prove the feasibility of obtaining these materials and to evaluate the impact of scale-up on the mechanical properties. The material has been obtained in three grades (different fractional alumina content) in strip, bar and plate form for initial evaluation. Yield strength, ultimate strength and fatigue behavior were measured and are reported. Review of the results together with metallurgical examination of fractured specimens and the requirements for the tokamak have led to concentration on one grade (0-3 wt% Alumina). Subscale plates have been produced for one of the grades and scale-up to full size is presently underway. 2 refs., 3 figs., 4 tabs.

38096 (CONF-891007--Vol.2, pp. 769-772) **Design and R and D for the central solenoid for the Compact Ignition Tokamak (CIT).** Thome, R.J. (Massachusetts Institute of Technology, Cambridge (USA)); Pillsbury, R.D. Jr.; Smith, B.A.; Vieira, R.; Thomas, P.; Olmstead, M.; Mann, W.R.; Winn, P.; Titus, P.; Myatt, L. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume*

2. Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The CR will require a liquid-nitrogen-cooled, pulsed poloidal field coil system for plasma heating, shaping and control. The central solenoid will have a bore diameter of 0.8 m., a height of 4.8 m., and a central field of 23-25 T. Geometric restrictions are such that an aggressive structural concept is required. Two options are being considered for the machine. The first would require a central solenoid which is self supporting and which would consist of a stack of explosively bonded copper/Alloy 718 plates with a copper/Alloy 718 ratio of 50/50. Each plate is cut into eight turns by a water jet cutting process. This paper presents features of this design and selected results from an R and D program which is under way. Full-scale plates have been fabricated and cut, and prototypical mechanical and electrical joints have been tested. The other machine design option would allow the central solenoid to receive partial support from the TF coil system. In this case the operating scenario and stresses are substantially different. R and D tasks have been started to evaluate conductor lifetime under simulated operating conditions for alumina dispersion strengthened (ADS) copper. Explosively bonded copper/Alloy 718 plates remain an option, but with a substantial increase in the ratio of copper to Alloy 718 to 70/30. A status of test results and plans for these materials is given. 8 refs., 7 figs., 1 tab.

38097 (CONF-891007–Vol.2, pp. 773-775) **Electrothermal evaluation of conductors for the Compact Ignition Tokamak (CIT) PF coils.** Winn, P. (Massachusetts Institute of Technology, Cambridge (USA)); Thome, R.J.; Thomas, P.; Pillsbury, R.D. Jr.; Gaudreau, M. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The coils in the PF system for CIT will be cooled to 80 K by liquid nitrogen between each machine pulse. During a pulse, the conductor temperature rises essentially adiabatically. Several conductors have been under consideration. These include an Alloy 718/copper/Alloy 718 laminate, alumina dispersion strengthened (ADS) copper, a laminate of copper and CuNb, and C107 copper. Electrothermal data on these materials is limited hence, a test program was performed to determine resistivity as a function of temperature from 80 K to 300 K and to determine the adiabatic characteristic sometimes referred to as the G function or action integral. This is, equivalently, the integral of current density squared over time for the sample or the integral of (density) x (specific heat)/(resistivity) over temperature for the material. The measurements naturally include the non-linear character of the properties with temperature. The integral is a direct measure of the adiabatic thermal capacity of the material for a specified rms current density over a time interval. Data have been taken on three grades of ADS copper, on laminates of copper and CuNb of two ratios, and on C107 copper. Functions have been computed for copper/Alloy 718 of different ratios. Results are given over the temperature interval from 80 K to 300 K. 2 refs., 6 figs., 1 tab.

38098 (CONF-891007–Vol.2, pp. 780-783) **Development of the proto-type conductors and design of the test coil for the fusion experimental reactor.** Nishi, M.F. (Japan Atomic Energy Research Institute, Ibaraki (Japan)); Takahashi, Y.; Isono, T.; Konno, M.; Yoshida, K.; Koizumi, K.; Tada, E.; Tsuji, H.; Okuno, K.; Ando, T. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Proto Toroidal Coil project is in progress. In this project, a proto-toroidal coil will be fabricated, and will be tested under conditions similar to the operating conditions of the toroidal coils of the fusion experimental reactor (FER), both electromagnetically and mechanically. Three types of 30 kA - 12 T forced-cooled conductors have been developed as the prototype conductors of the prototoroidal coil. Trial fabrication of these conductors and evaluation tests of their elements are now under way. Design work of the prototoroidal coil and its background field coil system, which consists of two LCT coils and two LCT back-up coils, is also in progress. 11 refs., 9 figs., 1 tab.

38099 (CONF-891007–Vol.2, pp. 784-787) **Poloidal field coil system optimization for the Compact Ignition Tokamak (CIT).** Pillsbury, R.D. Jr. (Massachusetts Institute of Technology, Cambridge (USA)); Thome, R.J. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

In the Compact Ignition Tokamak (CIT) design, the poloidal field (PF) coil system is located symmetrically about the Z = 0 plane. The system consists of seven pairs of coils external to the toroidal field (TF) coil system and two pairs of coils internal to the TF coils. The external PF coil system has three coils making up the central solenoid and four ring coils. Previous designs for CIT called for a self-supporting central solenoid (so called wedged design because the TF coil inner legs wedged under the radial inward loading) and a PF system capable of providing a flux swing and equilibrium and shaping fields for an 11 MA plasma. The present (bucked) design calls for a 12.3 MA plasma with a central solenoid that is partially supported by and partially supports the TF coil inner legs. This paper discusses the comparison of the two design options from the PF coil system standpoint. The operating points and structural and thermal requirements of the central solenoid lead to the selection of different conductors for the two cases. 3 refs., 6 figs., 1 tab.

38100 (CONF-891007–Vol.2, pp. 788-791) **Analysis of quench-vent pressures for present design of ITER [International Thermonuclear Experimental Reactor] TF [toroidal field] coils.** Slack, D.S. (Univ. of California, Livermore (USA)). Oak Ridge National Lab., TN (USA). [1989]. DOE Contract W-7405-ENG-48. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The International Thermonuclear Experimental Reactor (ITER) is a new tokamak design project with joint participation from Japan, the European Community, the Union of the Soviet Union, and the United States. This paper examines the effects of a quench within the toroidal field (TF) coils based on current ITER design. It is a preliminary, rough analysis. Its intent is to assist ITER designers while more accurate computer codes are being developed and to provide a check against these more rigorous solutions. Rigorous solutions to the quench problem are very complex involving three-dimensional heat transfer, extreme changes in heat capacities and copper resistivity, and varying flow dynamics within the conductors. This analysis addresses all these factors in an approximate way. The result is much less accurate than a rigorous analysis. Results here could be in error as much as 30 to 40 percent. However, it is believed that this paper can still be very useful to the coil designer. Coil pressures and temperatures vs time into a quench are presented. Rate of helium vent, energy deposition in the coil, and depletion of magnetic stored energy are also presented. Peak pressures are high (about 43 MPa). This is due to the very long vent path length (446 m), small hydraulic diameters, and high current densities associated with ITER's cable-in-conduit design. The effects of these pressures as well as the ability of the coil to be self protecting during a quench are discussed. 3 refs., 3 figs., 1 tab.

38101 (CONF-891007–Vol.2, pp. 795-798) **Fusion fuel purification during the Tritium Systems Test Assembly 3-week loop experiment.** Willms, R.S. (Los Alamos National Lab., NM (USA)); Anderson, J.L.; Bartlit, J.L.; Naruse, Y.; Okuno, K. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

During the time period from 4/19 - 5/5/89, the Tritium Systems Test Assembly (TSTA) at Los Alamos National Laboratory (LANL) conducted its longest continuous integrated loop operation to date. This provided an opportunity to test some hitherto unproven capabilities of the TSTA Fuel Cleanup System (FCU). Previous FCU tests were reported in [1]. The purpose of the FCU is to remove impurities from a stream of hydrogen isotopes (Q_2) representative of torus exhaust gas. During this run impurities loadings ranging from 60 to 179 sccm of 90% N_2 and 10% CH_4 were fed to the FCU. Each of the two FCU main flow molecular sieve beds (MSB's) were filled to breakthrough three times. The MSB's were regenerated during loop operations. 2 refs., 6 figs., 2 tabs.

38102 (CONF-891007–Vol.2, pp. 798-803) **Dispersion and removal of tritium released into the main cell of TSTA.** Bartlit, J.R. (Los Alamos National Lab., NM (USA)); Anderson, J.L.; Jalbert, R.A.; Carlson, R.V.; Okuno, K.; Ide, T.; Fukui, H.; Enoeda, M.; Naruse, Y. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Approximately 145 millicuries (about 0.06 cm^3) of tritium in DT form were released into the main cell of the Tritium Systems Test Assembly at Los Alamos National Laboratory. At equilibrium with the cell isolated, this amount resulted in concentrations of about 50 microcuries per cubic meter throughout the 2900 m^3 of the cell volume. Tritium was held in the cell for 29 minutes before normal ventilation was restored and the tritium was released through the facility's 30-m stack. The dispersion, confinement, removal, and decontamination times associated with this release are discussed in this paper. 5 refs., 7 figs., 3 tabs.

38103 (CONF-891007–Vol.2, pp. 761-765) **GlidCop dispersion strengthened copper: Potential applications in fusion power generators.** Troxell, J.D. (SCM Metal Products, Inc., Cleveland, OH (USA)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

GlidCo brand dispersion strengthened copper (DSC) has been widely accepted in applications requiring high electrical conductivity and high strength. Recent developments in the production of large plates have opened the door to potential applications in fusion power generating devices, specifically toroidal and poloidal field coils. GlidCop DSC is strengthened by an ultra-fine dispersion of Al_2O_3 articles through in situ internal oxidation of the aluminum in a dilute solid solution copper-aluminum alloy powder. Consolidation into a full dense material is accomplished by a wide variety of methods. Large slabs have been cold rolled 75% to produce typical tensile strengths of 482 MPa, yield strengths of 455 MPa and elongations of 10%. Thicker plates have only slightly lower strengths. Laboratory work shows that tensile strengths as high as 552 MPA can be achieved for plates which finish at 2.5 to 4mm. Electrical conductivity of this material is typically 90% IACS, and not influenced by cold reduction. At 77K GlidCop dispersion strengthened copper has a resistivity ratio of over 4:1, tensile strength of 669 MPa, yield strength of 572 MPa and elongation of 21%. Due to the high degree of thermal stability of the Al_2O_3 dispersoids, GlidCop DSC is highly resistant to softening after exposure to elevated temperatures, such as those used in brazing. The finely dispersed Al_2O_3 also serves to retard recrystallization. Test results indicate that GlidCop dispersion strengthened copper is highly resistant to swelling and the associated loss of electrical conductivity or strength after exposure to neutron irradiation. Despite exposures to temperatures of 687K and dosage levels of 34 dpa, about 90% of the electrical conductivity of the un-irradiated material was retained. 9 refs., 7 figs., 7 tabs.

38104 (CONF-891007–Vol.2, pp. 776-780) **Experiments of the 1-m-bore, 30-kA superconducting demo poloidal coils.** Okuno, K.; Tsuji, H.; Takahashi, Y.; Nakajima, H.; Kato, T.; Isono, T.; Ando, T.; Hiyama, T.; Nishi, M.; Tada, E. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Demo Poloidal Coil (DPC) program is in progress at JAERI and the first experiment on the Nb-Ti pulsed coils, DPC-U1 and -U2, was successfully performed. Both the coils have cable-in-conduit conductor cooled by 4-K supercritical helium, and their windings have 1-m inner and 2-m outer diameters. Charging tests on the coils were performed in both DC and pulsed modes. In DC mode, the coils were charged individually to their design current of 30 kA and attained a peak field of 5-2 T and a stored energy of 11 MJ. In pulsed mode, using the power supply of the JT-60, the designed pulsed field of 7 T/s was achieved by charging one of the two coils to its design current in 0.75 s. Ac losses of the coil during the pulsed operation was confirmed to be quite small. Mechanical, thermal, and hydraulic properties were also analyzed from the experiment. 7 refs., 8 figs., 1 tab.

38105 (CONF-891007–Vol.2, pp. 804-807) **The breeding blanket interface (BBI) and the tritium systems test assembly (TSTA).** Anderson, J. (Los Alamos National Lab., NM (USA)); Bartlit, J.; Sherman, R.; Sze, D.K.; Finn, P.; Clemmer, R.; Naruse, Y.; Yoshida, H.; Okuno, K.; Enoeda, M. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Tritium System Test Assembly (TSTA) project at Los Alamos National Laboratory is charged with developing and demonstrating the fusion fuel processing requirement for the magnetic fusion energy program. The key fusion fuel streams are the plasma exhaust and the blanket stream. At present, the technology under development at TSTA includes only the plasma exhaust. The blanket is a logical upgrade to TSTA. This possible upgrade is the subject of an ongoing study among LANL, JAERI, and Argonne National Laboratory (ANL). This program, called The Breeding Blanket Interface (BBI), is being investigated with the intention of installing such a processing system at TSTA in the 1992-1993 time frame. The BBI program was initiated in July 1987. The conditions of the tritium product streams of various blankets were determined. Preconceptual designs of the BBI systems were developed for two blanket concepts: Aqueous Lithium Salt Solution Blanket and Solid Breeder Blanket. Preliminary estimates of costing and the schedule of the TSTA/BBI program have been developed. This paper covers the schedule and planning of the TSTA/BBI program. The goal of the program is to establish the engineering data basis of the fuel cycle for an ITER type machine. The operation of the TSTA/BBI hardware is expected to cover the period of 1993 to 1996. 9 refs., 2 figs., 3 tabs.

38106 (CONF-891007–Vol.2, pp. 808-811) **Operation of the tritium process laboratory (TPL) in the Japan Atomic Energy Research Institute.** Naruse, Yuji (Japan Atomic Energy Research Institute, Ibaraki (Japan)); Matsuda, Yuji; Tanaka, Kichizo; Konishi, Satoshi. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Tritium Process Laboratory (TPL) in the Japan Atomic Energy Research Institute was constructed for the research and development of the fusion reactor fuel processing system and safe handling technology of a large amount of tritium. Total tritium inventory in the facility is 16g and each experiment will be conducted with grams of tritium. The facility is in operational with tritium since early 1988. No major tritium release or personnel doses occurred. Handling experience of tritium is being obtained. 9 figs., 2 tabs.

38107 (CONF-891007–Vol.2, pp. 812-815) **Uranium storage bed accident hazards evaluation.** Longhurst, G.R. (EG and G

Idaho, Inc., Idaho Falls (USA)); Shmayda, W.T. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

To properly assess hazards and risks associated with the use of uranium beds as tritium storage devices in fusion reactor systems, it is necessary to understand the consequences occurring in the event of an accident. Accidents involving uranium beds are postulated, and the possible results are considered. A research program to more fully and accurately understand those results has been initiated involving the Idaho National Engineering Laboratory and Ontario Hydro. The plan and objectives of that program are presented. 11 refs., 1 tab.

38108 (CONF-891007–Vol.2, pp. 816-818) **ITER [International Thermonuclear Experimental Reactor] guide for reliability analysis.** Buende, R. (Max Planck Institut fuer Plasmaphysik, Garching (West Germany)); Ollivier, G.; Flanagan, C.A. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Demanding reliability and availability (R and A) goals have been established for the International Thermonuclear Experimental Reactor (ITER). The credibility that such goals can be achieved depends on the implementation of a dedicated R and A assurance program from the outset of the design efforts. A guide for ITER reliability analyses has been prepared and preliminary results have been obtained. 6 figs.

38109 (CONF-891007–Vol.2, pp. 819-820) **TFTR CAMAC power supplies reliability.** Camp, R.A. (Princeton Univ., NJ (USA)); Bergin, W. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Since the expected life of the Tokamak Fusion Test Reactor (TFTR) has been extended into the early 1990's, the issues of equipment wear-out, when to refurbish/replace, and the costs associated with these decisions, must be faced. The management of the maintenance of the TFTR Central Instrumentation, Control and Data Acquisition System (CICADA) power supplies within the CAMAC network is a case study of a set of systems to monitor repairable systems reliability, costs, and results of action. The CAMAC network is composed of approximately 500 racks, each with its own power supply. By using a simple reliability estimator on a coarse time interval, in conjunction with determining the root cause of individual failures, a cost effective repair and maintenance program has been realized. This paper describes the estimator, some of the specific causes for recurring failures and their correction, and the subsequent effects on the reliability estimator. By extension of this program the authors can assess the continued viability of CAMAC power supplies into the future, predicting wear-out and developing cost effective refurbishment/replacement policies. 4 refs., 3 figs., 1 tab.

38110 (CONF-891007–Vol.2, pp. 821-824) **Quality assurance and quality control for the confinement physics research facility (CPRF) and ZTH experiment.** Kewish, R.W. Jr. (Los Alamos National Lab., NM (USA)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

In compliance with DOE order 5700.6B, which establishes policies to assure quality achievement in DOE programs, the authors instituted a quality assurance and quality control program whose primary goal is to assure that reliable components are available with which to assemble the CPRF/ZTH experiment. The Code of Federal Regulations 10 CFR 50, Appendix B, and the ANSI standard N45.2 were used as a primary source of guidance in establishing a plan for our QA program. Accepted codes, such as the National Electric Code (NEC), and standards adopted by organizations such as ANSI, IEEE, ASME, and NEMA were used in the design and production of components in keeping with the primary goal of the CPRF program. In setting up the CPRF/ZTH quality assurance program it was their intention to have these standards apply to all suppliers, both within and outside the Laboratory. 5 refs., 5 figs.

38111 (CONF-891007–Vol.2, pp. 827-829) **CPRF/ZTH front-end torus design and fabrication status.** Ballard, E.O. (Los Alamos National Lab., NM (USA)); Baker, C.; Gomez, T.; Prince, P.P.; Smith, R.L. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Design of the ZTH front-end torus has been completed for a new generation Reversed Field Pinch (RFP) machine to be assembled at Los Alamos National Laboratory during FY 92. The Confinement Physics Research Facility (CPRF) houses the ZTH front-end torus. The ZTH torus consists of an Inconel 625 vacuum vessel supported by an external electrically conducting 304L stainless steel shell. Interspace support rings support the vacuum vessel to the shell and also provide accurate radial support for the interspace electrical diagnostics. The shell also supports 48 toroidal field coils that are mounted to the shell's external surface. The shell consists of an explosion bonded stainless steel-copper composite with water-cooling tube assemblies attached to the outer surface. The 0.135-in. thick copper is on the inside surface of the shell, and provides an electrically conducting path with the required electrical time constant of 50 ms. The shell plate will be formed to the required toroidal configuration, after which the poloidal and toroidal flanges will be welded to the structure and machined. The Inconel vacuum vessel consists of bellows segments, armor support rings, and diagnostic stations welded together to form the complete vacuum vessel assembly. The necessity for accurate positioning of the vacuum vessel within the shell requires that the shell and vacuum vessel be fabricated with major diameter tolerances within 0.050-in. true position of the nominal diameters of 188.0-in. and 188.820-in., respectively. 7 figs.

38112 (CONF-891007–Vol.2, pp. 830-833) **COMPASS electrical systems and commissioning.** Bayes, D.V. (Culham Lab., Oxon (England)); Hay, J.H.; Martin, M.A.; Richardson, D. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The COMPASS experiment is designed to operate in both Pinch and Tokamak modes, the latter with both circular and shaped plasma cross-sections. In Tokamak mode, the primary windings are used as an inductive store with a two stage opening switch system to transfer the energy to the plasma loop. Three thyristor converters (total power 17MW) are used to maintain the plasma current, to provide vertical equilibrium field and to produce the required plasma shapes (e.g. dee, ellipse, etc). For Pinch operation, a conventional start bank/active crowbar circuit is used to feed a reconfigured winding arrangement. Three high power (each 250 kW) transistor amplifiers are used to energize other machine windings to provide vertical and radial correction fields for fast control of plasma position. A thyristor rectifier (40MVA) is used to supply the toroidal field system (92kA/turn for max. field of 2.1T). The control system uses programmable controllers controlled by a central computer. The operating interface is through touch-sensitive color monitors. 4 refs., 5 figs., 1 tab.

38113 (CONF-891007–Vol.2, pp. 846-849) **Technological aspects in the production of a large aluminum shell.** Baker, W.R. (Culham Lab., Abingdon (England)); Bevilacqua, G.; Carretta, R.;

Saccardo, B.; Elio, F.; Fauri, M.; Gnesotto, F.; Saccardo, B. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

To minimize MHD instabilities in the external plasma region, the Reverse Field Pinch experiments should be equipped with a stabilizing shell, made of a high conductivity material and fitted as near as possible to the plasma edge. The paper describes the most significant technologies adopted for the construction of the stabilizing shell of the RFX Project. In particular it deals with the forming and machining processes to produce the shell quarters and with the technology adopted for the electrical insulation of the vertical gaps, characterized by high mechanical and dielectric stresses. The paper gives the details of these technologies and reports the main test results. 7 refs., 9 figs.

38114 (CONF-891007–Vol.2, pp. 850-853) **Fusion propulsion systems.** Haloulakos, V.E. (McDonnell Douglas Astronautics Co., Huntington Beach, CA (USA)); Bourque, R.F. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The continuing and expanding national efforts in both the military and commercial sectors for exploration and utilization of space will require launch, assembly in space, and orbital transfer of large payloads. The currently available delivery systems, utilizing various forms of chemical propulsion, do not have the payload capacity to fulfill the planned missions. National planning documents such as Air Force Project Forecast II and the National Commission on Space Report to the President contain numerous missions and payload delivery schedules that are beyond the present capabilities of the available systems, such as the Space Shuttle and the Expendable Launch Vehicles (ELVs). The need, therefore, is very pressing to design, develop, and deploy propulsion systems that offer a quantum level increase in delivered performance. One such potential system is fusion propulsion. This paper summarizes the result of an Air Force Astronautics Laboratory (AFAL) sponsored study of fusion propulsion conducted by the McDonnell Douglas Astronautics Company (MDAC), and its subcontractor General Atomics This study explored the potential of fusion propulsion for Air Force missions. Fusion fuels and existing confinement concepts were evaluated according to elaborate criteria. Two fuels, deuterium-tritium and deuterium-helium 3 (D-^{3}He) were considered worthy of further consideration. D-^{3}He was selected as the most attractive for this Air Force study. The colliding translating compact torus confinement concept was evaluated in depth and found to possibly possess the low mass and compactness required. Another possible concept is inertial confinement with the propellant surrounding the target. 5 refs., 5 figs., 8 tabs.

38115 (CONF-891007–Vol.2, pp. 854-857) **COMPASS mechanical design and construction.** Hayward, R.J. (Culham Lab., Oxon (England)); Crawley, P.J.; Crossland, R.T.; Ingram, B.S.; Pratt, A.P.; Smith, R.T.C. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

COMPASS is a compact toroidal experiment [1] designed to achieve the following physics objectives: Establish conditions for the active control of disruptive instabilities in circular and non-circular plasmas by external fields and by the control of the current profile. Operation of a circular tokamak at low q ({ <=} 2) on long timescales using instability and profile control, thereby leading to higher β. Optimization of β using a non-circular plasma cross-section with current profile control and the study of the relationship between β and confinement at the highest possible β. Possible implementation of a near continuously operating tokamak using cyclotron waves to drive the plasma current. Operation at ultra low q leading to a reverse field pinch (RFP) without the necessity of a thick conducting shell. Two quite different vacuum vessels are required to meet the physics objectives and the design of toroidal and poloidal coils and their support systems is strongly influenced by the necessity to change vessels during the life of the experiment. A flush 91kA joint is required in the turns of the toroidal coils and a large number of poloidal windings are necessary to achieve the many different plasma shapes required. The design is further complicated by the low aspect ratio, R/a = 2.4 with a major radius of R = 0.557m. A cut away view of the load assembly with the circular section vacuum vessel installed is shown in Fig. 1 with a cross-section of the assembly in Fig. 2. The main parameters of the experiment are listed. 4 refs., 2 figs., 1 tab.

38116 (CONF-891007–Vol.2, pp. 858-861) **Analysis of the poloidal field system leads in the IGNITEX experiment.** Montalvo, E. (Univ. of Texas, Austin (USA)); Carrera, R.; Dong, J.; Driga, M.; Hsieh, K.; Walls, A.; Weldon, W. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Some aspects of the operation of the poloidal field (PF) system of the IGNITEX experiment are analyzed. Stresses in the PF system due to the poloidal magnetic field are calculated for unsupported PF coils. When the structural eddy currents are taken into account, the stresses are considerably reduced. Stresses in the PF terminals due to the toroidal magnetic field are calculated for a terminal partially supported by the toroidal field (TF) magnet. The maximum stresses occur in the lead located in the TF inner leg at the end of the flat top of the discharge. Both stresses in the PF coils and the PF terminals are tolerable. Finally, a preliminary estimate of the perturbed vacuum magnetic field at breakdown has been done to provide insight for the detailed design of the PF terminals. 6 refs., 10 figs.

38117 (CONF-891007–Vol.2, pp. 866-868) **Design of the start experiment.** Smith, R.T.C. (Culham Lab., Abingdon (England)); Booth, J.A.; Haynes, P.S.; Hender, T.C.; Hicks, J.B.; Sykes, A.; Todd, T.N.; Peng, Y.K.; Whitson, J. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The START experiment (Small Tight Aspect Ratio Tokamak) is a low-budget device, now under construction at Culham, specifically intended to investigate MHD behavior at extremely tight aspect ratios (as low as R/a $\sim$ 1.2) and the effectiveness of a major radius compression technique to produce high toroidal current in such plasmas. 1 ref., 4 figs.

38118 (CONF-891007–Vol.2, pp. 869-873) **Radiation shielding analysis for DIII-D.** Kim, Jinchoon (General Atomics, San Diego, CA (USA)); Boshoven, J.K.; Callis, R.W.; Luxon, J.L.; Petersen, P.I.; Su, S. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC03-89ER51114. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A radiation shield has been added to the DIII-D tokamak facility to allow increased neutron production rate without increasing the radiation exposure to the public and to the personnel. The goal of the shield is to reduce the biological dose level at the site boundary by a factor of 300. Shielding analyses were performed extensively using a 3-D Monte Carlo neutron photon coupled code, MCNP, for varied geometry and material combinations. The calculated total dose at the site boundary 83 m away from the tokamak are approximately 10^{-17} mrem per D-D neutron with the new

shield in place and 3×10^{-15} mrem without the new shield. 13 refs., 5 figs., 3 tabs.

38119 (CONF-891007–Vol.2, pp. 878-881) **Calculation of neutron and γ production and transport for the Alcator C-Mod experiment.** Fiore, C.L. (Massachusetts Institute of Technology, Cambridge (USA)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Deuterium operation in Alcator C-Mod is expected to produce up to 1×10^{16} neutrons/s during high performance pulses (1 second duration) with full rf power (6 MW). Neutron production during optimized Ohmic operation should reach 1×10^{15} neutrons/s. Energy resolved neutron transport calculations have been made for Alcator C-Mod, using both the one-dimensional ANISN code (for deep penetration and activation calculations) and the three dimensional MCNP code (for wall penetrations and near-machine calculations.) The results are used to assess the extent of radiation related health risks imposed by the experiment (anticipated dose rates due to direct radiation exposure, material activation, airborne activity), and then to establish the efficacy of the biological shielding which surrounds the experimental cell. The calculations are used to determine the necessary monitoring and access control for the experiment, and to optimize the design of an igloo structure which will enclose the tokamak. 8 refs., 4 figs., 1 tab.

38120 (CONF-891007–Vol.2, pp. 882-885) **Numerical simulation of turbulent gas-particle fluid flow and heat transfer.** Kunugi, Tomoaki (Univ. of California, Los Angeles (USA)); Hasan, M.Z. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The ARIES-I blanket utilizes SiC-composites as the structural material and pure 5MPa He gas. A previous choice was to use 0.5MPa CO_2 gas with particulates as the primary coolant. In this option with CO_2 gas, these small particles mixed with the coolant gas act as a circulating-bed heat transfer medium resulting in a reduced system pressure, a reduced pumping power for coolant circulation, and a higher heat transfer coefficient. Although the addition of solid particles increases the heat transfer coefficient, the physical mechanism is not fully understood. In this study, a computer code using an algebraic second order closure model (ASM) for the continuous phase and a stochastic separation flow model (SSF) for the particulate phase is employed to investigate the microscopic and macroscopic fluid dynamic and heat transfer behaviors of the gas-particulate mixture flow. First, the authors confirm the validity of this code for a single phase impinging wall jet flow, and then they apply it to a gas-particulate flow through a circular pipe. The variables in this study are the particle size, loading ratio, Reynolds number and the pipe diameter. This paper describes some preliminary results concerned with the particle size and Reynolds number. The velocity profiles, turbulence quantities and temperature distributions are obtained and are compared with the experimental ones. It is found that this code can be applied to the gas-particle flow simulation in a pipe. However, one need to carry out further calculations and investigate the physical mechanism and the modeling of this gas-particle flow and heat transfer phenomena in order to obtain a fully understanding. 20 refs., 10 figs.

38121 (CONF-891007–Vol.2, pp. 886-889) **Tritium analysis of a water-cooled solid breeder blanket for ITER.** Federici, G. (Univ. of California, Los Angeles (USA)); Raffray, A.R.; Abdou, M.A. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract FG03-86ER52123. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

This paper presents quantitative predictions for the tritium release and inventory in a water-cooled solid breeder blanket for the International Thermonuclear Experimental Reactor (ITER) obtained from the tritium transport code MISTRAL [1] recently developed at UCLA. The blanket consists of a layout assembly of solid breeder and beryllium multiplier, with two layers of solid breeder in the outboard region and one layer in the inboard region [2]. The analysis includes steady-state inventory evaluations as well as transient calculations under assumed ITER pulsed operation. Different scenarios were investigated including operation at reduced power level. Key parameters affecting the kinetics of the tritium release and the inventory evolution considered in the investigation and discussed in this paper include the solid breeder microstructure, the purge gas composition and the operating burn and dwell times. 6 refs., 10 figs., 3 tabs.

38122 (CONF-891007–Vol.2, pp. 894-897) **Liquid metal mist cooling and MHD Ericsson cycle for fusion energy conversion.** Greenspan, E. (Univ. of California, Berkeley (USA)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The combination of liquid metal mist coolant and a liquid metal MHD (LMMHD) energy conversion system (ECS) based on the Ericsson cycle is being proposed for high temperature fusion reactors. It is shown that the two technologies are highly matchable, both thermodynamically and physically. Thermodynamically, the author enables delivering the fusion energy to the cycle with probably the highest practical average temperature commensurate with a given maximum reactor design constraint. Physically, the mist cooling and LMMHD ECSs can be coupled directly, thus eliminating the need for primary heat exchangers and reheaters. The net result is expected to be a high efficiency, simple and reliable heat transport and ECS. It is concluded that the proposed match could increase the economic viability of fusion reactors, so that a thorough study of the two complementary technologies is recommended. 11 refs., 3 figs.

38123 (CONF-891007–Vol.2, pp. 898-904) **Equilibrium shape control in CIT PF design.** Strickler, D.J. (Oak Ridge National Lab., TN (USA)); Pomphrey, N.; Jardin, S.C. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The free-boundary equilibrium code VEQ provides equilibrium data that are used by the Tokamak Simulation Code (TSC) in design and analysis of the poloidal field (PF) system for the Compact Ignition Tokamak (CIT). VEQ serves as an important design tool for locating the PF coils and defining coil current trajectories and control systems for TSC. In this paper, VEQ and its role in the TSC analysis of the CIT PF system are described. 7 refs., 5 figs., 6 tabs.

38124 (CONF-891007–Vol.2, pp. 862-865) **Assembly procedures and thermal and mechanical performances during the commissioning phase of the FTU machine.** Cecchini, A. (Associazione EURATOM-ENEA, Rome (Italy)); Gasparotto, M.; Migliori, S.; Morelli, F.; Pizzuto, A. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The paper reports the main engineering features of the toroidal machine, the remote handling tools for cutting and welding the vacuum vessel and the machine assembly installation procedures. Finally the first engineering experimental results are illustrated. 3 refs., 6 figs., 2 tabs.

38125 (CONF-891007–Vol.2, pp. 874-877) **Radiation shielding for TFTR D-T operation.** Rocco, R.E. (Ebasco Services Inc., Princeton, NJ (USA)); Pan, A.; Pien, C.; Wang, C.R. Oak Ridge

National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Deuterium-Tritium (D-T) operation of the TFTR machine will require extensive radiation shielding to satisfy biological as well as equipment operating objectives. Shielding design objectives include limiting the radiation dose rate at the site boundary to a prescribed level and limiting the neutron and gamma flux to levels which were determined to minimize electrical noise in diagnostic equipment and to avoid damaging electrical components. This paper discusses the design and engineering approach taken to provide the shielding necessary to meet these objectives. The final shielding configuration, which includes the close fitting machine igloo and the ancillary equipment enclosures, is presented; material types and component dimensions are identified. Included is a discussion of the design and installation schedule which was developed to assure the timely and efficient installation of the shielding. The design and analysis effort is discussed, with particular attention given to the finite element analysis. A section is included which describes the construction materials chosen to meet the shielding and the machine operating requirements. Design details are presented with special emphasis placed on constructibility and the measures taken to minimize interference with other test cell work. The D-T shielding work was curtailed in November 1988 as a result of budget cuts. Present plans are to resume with the preparation of the D-T phase in two to three years. A description is included of the orderly shutdown effort which was conducted to assure efficient resumption of the shielding work. 3 refs., 6 figs.

38126 (CONF-891007–Vol.2, pp. 890-893) **Center conductor design for the compact Spherical Torus reactor.** Snead, L.L. (Rensselaer Polytechnic Institute, Troy, NY (USA)); Steiner, D. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Spherical Torus (ST) concept has been proposed as a means of achieving high plasma β at low aspect ratio and low magnetic field. When the aspect ratio of a torus is reduced below ~2, the inboard space available for shielding can become inadequate for superconducting magnets, and normal conducting coils must be adopted. The design of the normal conducting center post is a key engineering issue for the ST. A typical Spherical Torus reactor with aspect ratio of 1.22 and major radius 1.43 m. gives a center conductor radius of 20.5 cm. For such a small radius it is apparent that including any shielding will drastically increase the conductor current density and, thereby increase the resistive loss of the conductor. A normal center post with no inboard shielding will exhibit high levels of radiation damage to the conductor. Calculations show that the average neutron wall loading can be as high as 9.5 MW/m^2, leading to more than one hundred displacements per atom in the copper after a year of full power operation. This damage will increase the already sizeable resistive loss and may result in mechanical and thermal-hydraulic problems. In this study, the center post performance is analyzed as a function of operating time for a representative Spherical Torus reactor with the following parameters: Thermal Power, 2,000 MW; Major Radius, R_{maj}, 1.43 m; Minor Radius, a, 1.17 m (A=1.22); Elongation, κ, 2.2; Toroidal Field on axis, B_{to}, .824 T. The key engineering issues for the center post design are the resistive loss, magnet coolant velocity, conductor temperature and physical erosion of the magnet by the coolant flow. 9 refs., 9 figs.

38127 (CONF-891007–Vol.2, pp. 913-916) **Active plasma position and current feedback control in the FTU tokamak machine.** Crisanti, F. (Associazione EURATON-ENEA sulla Fusione, Rome (Italy)); Santinelli, M. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

In the FTU machine there are the following coils: main transformer coil (T), preprogrammed vertical field coil (V) and feedback coil (F). In order to maximize the number of the ports for diagnostics apparatus and additional RF heating, FTU has been designed without a massive copper shell. Plasma displacements due to preprogramming failures or disruptions, will be recovered by the vertical field generated by the coil. In addition, also the plasma current is feedback controlled by regulating the transformer current. To study the control laws and to optimize the regulation gains, a computer code based on the CSMP III (continuous system modeling program) has been provided. 4 refs., 6 figs.

38128 (CONF-891007–Vol.2, pp. 917-920) **A radiation-cooled armor tile design for the first wall of ITER (International Thermonuclear Experimental Reactor).** Gallix, R. (General Atomics, San Diego, CA (USA)); Baxi, C.; Reis, E.; Schultz, K. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

This work was performed as a contribution by the U.S. Plasma Facing Components engineering team to the concept definition effort for the International Thermonuclear Experimental Reactor (ITER). In the ITER device, frequent plasma disruptions are expected during the first phase of operation, which will be devoted to plasma physics. Armor is required to protect the stainless steel first wall (FW) against the intense heat pulses caused by these disruptions. Based on successful experience in many operating fusion devices, graphite is proposed as the leading armor tile material for ITER during the first phase of operation. The tile design presented here uses radiation rather then conduction to transfer heat to the water-cooled first wall. The central, thermally insulated tile attachment minimized local thermal stresses in the first wall and facilitates remote maintenance. The tile module consists of: a graphite tile; layers of anisotropic pyrolytic carbon used as a high-temperature thermal insulator; a metallic mounting plate; carbon-reinforced carbon (C-C) screws which join the tile, the insulator and the mounting plate together; and a captive, central mounting screw. The design emphasized simplicity and ruggedness while minimizing the need for R and D. The results of a detailed, two-dimensional heat transfer and thermal stress analysis are presented for steady-state heat fluxes of 20 and 100 W/cm^2. The effects of neutron heating, radiation conduction, contact resistances, material anisotropy, temperature dependencies, and sliding interfaces are considered. The calculated temperatures and stresses show that the proposed tile design is feasible. 5 figs., 2 tabs.

38129 (CONF-891007–Vol.2, pp. 921-926) **An assessment of the lifetime of Faraday shield elements.** Caughman, J.B.O. II (Univ. of Illinois, Urbana (USA)); Ruzic, D.N.; Hoffman, D.J.; Langley, R.A.; Lewis, M.B.; Ryan, P.M. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The interaction of plasma with rf fields from an ion cyclotron range of frequencies (ICRF) antenna has been studied to estimate the amount of Faraday shield erosion expected in normal ICRF heating (ICRH) operation. Plasma parameters and ion energies have been measured in the near field of an antenna and used in a model to estimate the erosion rate of the Faraday shield surface. Experiments were conducted on the RF Test Facility (RFTF), a magnetic mirror device at Oak Ridge National Laboratory (ORNL), using a single-strap resonant loop antenna with a two-tier Faraday shield. The outer tier, facing the plasma, was layered with graphite tiles. The antenna was operated at currents and voltages (~500 A, ~20 kV at 25 kW) within 50% of those expected in tokamaks. The time varying floating potential was measured with a capacitively coupled probe, and the time-averaged floating potential, electron temperature, and electron density were measured with a Langmuir

probe. Both probes were scanned in front of the antenna. Ion energies were measured with a gridded energy analyzer located below the antenna, and samples of silicon were placed on the Faraday shield surface to estimate the incident ion energy. The capacitive probe measurements show that the rf floating potential follows the magnetic field pattern of the antenna, indicating that the electromagnetic fields are responsible for the potential formation. Plasma parameters and ion energies have been correlated with the antenna current and used in s computational model of the plasma sheath to predict the amount of erosion expected from the Faraday shield elements exposed to plasma. Predictions of light ion sputtering of candidate Faraday shield materials are presented. 19 refs., 6 figs., 1 tab.

38130 (CONF-891007–Vol.2, pp. 927-930) **Impurity release disruption effects, and thermomechanical stress analysis of the first wall system for the IGNITEX experiment.** Ordonez, C.A. (Univ. of Texas, Austin (USA)); Carrera, R.; Edmonds, P.H.; Howell, J.; Rodin, G.; Howe, H.C. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A first wall design and analysis for the proposed IGNITEX ignition experiment is presented. Tile design of the first wall system emphasizes the following aspects: (1) plasma cleanness; (2) simplicity of design; (3) minimum complexity of remote maintenance systems and operation; (4) minimum cost. A limiterless first wall is considered which consists of an amorphous carbon film applied to a beryllium substrate. The beryllium is applied to the vacuum vessel by plasma jet spraying. Based on the limiterless geometry, impurity release during operation is estimated. Discharges are simulated with the PROCTR one dimensional plasma transport code. Sputtering and helium ash recycling are considered as main mechanisms of impurity release from the first wall. A new sputtering yield calculation for carbon surfaces is presented based on Monte Carlo studies (TRIM two dimensional ion implantation code). Disruption effects are simulated with the code DISRUP which accounts for vapor shielding effects. Evaluations of wall erosion under various disruptive scenarios are presented. Thermomechanical stresses are calculated using the finite elements program ABAQUS. First wall system preconditioning between experimental pulses is outlined. 12 refs., 5 figs., 2 tabs.

38131 (CONF-891007–Vol.2, pp. 931-936) **A comparison between hypervapotron and multitube high heat flux beam stopping elements.** Altmann, H. (JET Joint Undertaking, Oxfordshire (England)); Falter, H.D.; Hemsworth, R.S.; Martin, D.; Papastergiou, S.; Tivey, R.B. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Structures capable of accepting high heat fluxes ({ >=} 10MW/m^2) in steady state are an important aspect of fusion engineering. The hypervapotron principle has been used successfully in the JET Neutral Beam Injectors at power densities up to 10 MW/m^2. Tests have been carried out in the JET Neutral Injection Test Bed to assess the safe operating limits of these elements which form the basic sub-unit from which larger components (beam dumps, scrapers, etc.) are assembled. In addition, a multi-channel water cooled element (multitube) has been developed and tested as a possible alternative to the hypervapotron. The results from these tests are reported and a comparison is made between the data obtained from the two types of elements. In particular, the dependence of the peak power density limit as a function of total incident power, coolant flow and pressure are presented. Measured and computed temperature profiles in the elements are used to assess the internal stresses and their subsequent implications for the fatigue life. Both the hypervapotron and the multitube type of element are shown to be suitable for the 140 kV deuterium and ultimately the 160 kV tritium Neutral Beam Injectors for JET. 5 refs., 13 figs., 1 tab.

38132 (CONF-891007–Vol.2, pp. 947-950) **A carbon-carbon panel design concept for the inboard limiter of the Compact Ignition Tokamak (CIT).** Mantz, H.C. (McDonnell Douglas Missile Systems Co., St. Louis, MO (USA)); Bowers, D.A.; Williams, F.R.; Witten, M.A. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The inboard limiter of the Compact Ignition Tokamak (CIT) must protect the vacuum vessel from the plasma energy. This limiter region must withstand nominal heat fluxes in excess of 10 MW/m^2 and in addition it must be designed to be remotely maintained. Carbon-carbon composite material was selected over bulk graphite materials for the limiter design because of its ability to meet the thermal and structural requirements. The structural design concept consists of carbon-carbon composite panels attached to the vacuum vessel by a hinged rod/retainer concept. Results of the preliminary design study to define this inboard limiter are presented. The design concept is described along with the analyses of the thermal and structural response during nominal plasma operation and during plasma disruption events. 2 refs., 8 figs.

38133 (CONF-891007–Vol.2, pp. 951-954) **Thermal design and analysis of DIII-D advanced divertor.** Baxi, C.B. (General Atomics, San Diego, CA (USA)); Reis, E.; Smith, J. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC03-89ER51114. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The DIII-D tokamak uses divertor plasma configurations to obtain enhanced plasma confinement. These configurations are prototypical of CIT and ITER. To further develop the divertor capability, a combined divertor baffle and electrically isolated toroidal ring electrode will be installed. The high heat flux and elevated temperatures pose challenging design problems especially for the insulating materials. The toroidal ring support structure for the divertor must withstand a peak heat flux of 600 W/cm^2 for a period of 5 sec. During operation, the advanced divertor is electrically biased relative to the vessel. To provide cross field electrical insulation between the divertor and the vessel, parts of the shelf and the floor tiles will be fabricated from non-conducting materials which will be subjected to both high heat flux and a high temperature environment. To obtain an acceptable design, thermal analyses were performed to calculate the temperature differences between the divertor structure and the vessel wall during periods of bakeout and during plasma operation. In addition, a number of finite element thermal stress analyses of individual components were done to insure acceptable temperatures and stresses. 7 refs., 6 figs.

38134 (CONF-891007–Vol.2, pp. 955-958) **Metal/graphite - composites in fusion engineering.** Staffler, R. (Metallwerk Plansee GmbH, Reutte (Austria)); Kneringer, G.; Kny, E.; Reheis, N. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Metal/graphite composites have been well known in medical industry for many years. X-ray tubes used in modern radiography, particularly in computerized tomography are equipped with rotating targets able to absorb a maximum of heat in a given time. Modern rotating targets consist of a refractory metal/graphite composite. Today the use of graphite as a plasma facing material is one predominant concept in fusion engineering. Depending on the thermal load, the graphite components have to be directly cooled (i.e. divertor plates) or inertially cooled (i.e. firstwall tiles). In case of direct cooling a metallurgical joining such as high temperature brazing between graphite and a metallic cooling structure shows the most promising results /1/. Inertially cooled graphite tiles have

to be joined to a metallic backing plate in order to get a stable attachment to the supporting structure. The main requirements on the metallic partner of a metal/graphite composite used in the first wall area are: high melting point, high thermal strength, high thermal conductivity, low vapor pressure and a thermal expansion matching that of graphite. These properties are typical for the refractory metals such as molybdenum, tungsten and their alloys. 4 refs., 13 figs., 1 tab.

38135 (CONF-891007–Vol.2, pp. 959-962) **Co-pumping of deuterium-helium and tritium-helium mixtures at TSTA.** Walthers, C. (Los Alamos National Lab., NM (USA)); Sedgley, D.; Batzer, T.; Lang, D.; Hathaway, D.; Fukai, H.; Okuno, K.; Enoeda, N.; Ide, T.; Naruse, Y. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Future fusion experimental devices and power reactors will pump continuously large amounts of helium, and deuterium and tritium (DT). DT to helium ratios greater than 10:1 are projected. Cryopumps are the logical choice to pump gases in the 100 cubic meter per second range. Compound cryopumps, although complex, have been indicated as the preferred method: these pumps will separately pump helium and DT and will provide to the fuel clean-up system relatively helium free DT gas. Recent study however, shows that helium can be proceeded in the fuel cleanup system, negating the need for separate regeneration. A test program undertaken at Los Alamos evaluated the capability of co-pumping the fusion exhaust gases on a liquid helium cooled surface of activated carbon (coconut charcoal). A compound cryopump installed in the VAC system of the Tritium Systems Test Assembly was used as the test article. In the test program, co-pumping of helium and deuterium and helium-3 and tritium was undertaken. Test results show that co-pumping is practical and that compound pumps may not be required for fusion applications. 5 refs., 7 figs.

38136 (CONF-891007–Vol.2, pp. 963-967) **Gas handling for the Tokamak Fusion Test Reactor during the DT phase of operation: System overview.** LaMarche, P.H. (Princeton Univ., NJ (USA)); Dylla, H.F.; Martin, G.D.; Raftopoulos, S.; Rossmassler, R.L.; Sissingh, R.A.P. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

TFTR is preparing for operation with tritium, scheduled for 1993. The gas handling systems of TFTR will be reconfigured to take advantage of systems that store for batch processing the safer elemental isotopes of hydrogen, use of impurity pumping cryopumps to reduce the amounts of tritium necessary to condition the tokamak, and methods to address off-normal events on TFTR. 8 refs., 2 figs., 2 tabs.

38137 (CONF-891007–Vol.2, pp. 968-971) **Thermal analysis of the CPFR/ZTH apparatus.** Schnurr, N.M. (Los Alamos National Lab., NM (USA)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The design has been completed for a new-generation Reversed-Field Pinch machine to be assembled at the Los Alamos National Laboratory during FY 1992. The Confinement Physics Research Facility (CPRF) houses the front-end ZTH torus. A series of simulations has been performed to predict temperature levels for various elements within the front end of the CPRF/ZTH apparatus for bakeout conditions and for periodic experiments. A lumped-parameter approach was used to calculate temperatures of various elements as functions of time. Results indicate that temperatures can be held at acceptable levels for 10-min cycles for the 2-MA design condition. The cycle time must be extended to approximately 13 min for 4-MA experiments. Instrumentation temperatures during bakeout were also found to be within acceptable limits. 2 refs., 7 figs., 1 tab.

38138 (CONF-891007–Vol.2, pp. 972-973) **The use of cryopumps for impurity pumping during the TFTR D-T phase.** Martin, G.D. (Princeton Univ., NJ (USA)); Dylla, H.F.; La Marche, P.H.; Sissingh, R.A.P. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The introduction of tritium into the plasmas of the controlled fusion program will require stringent control and processing of effluents from the vacuum system. This paper will discuss one aspect of the new processing requirements, that is, the reduction in the amount of gas required for discharge cleaning of vacuum vessel during D-T operations. A steady state glow discharge at pressures of 5×10^{-3} torr (D_2) for periods of up to 24 hours are currently performed as part of the procedure to prepare the TFTR vacuum system for high power pulsing. The present vacuum system with a speed of 5,000 1/sec would generate about 5 moles of tritium contaminated effluent per hour. Purification and real time recycling of the discharge cleaning gas using a Stirling cycle cryopump (10°K to 20°K) in series with a turbopump would reduce the discharge cleaning gas requirements to a single gas filling. The usual charcoal coating on the low temperature stage of the cryopump will be removed to prevent hydrogen isotope sorption pumping. Impurities such as CO, H_2O, CH_4, etc., will be cryopumped on the 80°K and 10-20°K cryo-surfaces. At the termination of glow discharge cleaning a single charge (250 torr liters) of tritium contaminated gas will be transferred to a tritium clean-up system, possibly for recycling. The cryopump is then regenerated and the tritium contaminated impurities are transferred to the tritium clean-up system. 3 refs., 1 fig.

38139 (CONF-891007–Vol.2, pp. 974-977) **The construction of the RFX vacuum vessel.** Baker, W.R. (Culham Lab., Abingdon (England)); Bevilacqua, G.; Parma, A.; Rigadello, D.; Elio, F.; Sonato, P.; Gnesotto, F. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The paper describes the technologies adopted for the construction of the RFX vacuum vessel. It is an all-welded Inconel 625 construction with very tight dimensional tolerances: 1 mm on the 4 m major diameter and 0.5 mm on the 1 m minor diameter. Welding the thin Inconel sheets to build up the sandwich structure of the wall has been one of the most significant aspects of the construction. A lot of machining was necessary to obtain the exact dimensions on the single welded components of the vessel. Special attention was paid to the flange fabrication: most of them are equipped with Helicoflex seals to house optical windows of various materials and different shapes, operating under thermocycling conditions. The procedures for leak testing and for surface cleaning are reported, along with the assembly operations and controls. 4 refs., 7 figs., 1 tab.

38140 (CONF-891007–Vol.2, pp. 978-982) **Location and repair of air leaks in the ATF vacuum vessel.** Schwenterly, S.W. (Oak Ridge National Lab., TN (USA)); Gabbard, W.A.; Schaich, C.R.; Yarber, J.L. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

On the basis of partial pressure rate-of-rise and base pressure measurements, it was determined that the Advanced Toroidal Facility (ATF) vacuum vessel had an air leak in the low 10^{-4} mbar$\times\ell$/s range. Pinpointing this leak by conventional helium leak-checking procedures was not possible, because large portions of the outside of the vessel are covered by the helical field coils and a structural

shell. Various alternative leak detection schemes that were considered are summarized and their advantages and disadvantages noted. In the method ultimately employed, gum-rubber patches of various sizes ranging from 12.7 by 12.7 cm to 20.3 by 30.5 cm were positioned on the inside surfaces of the vessel and evacuated by the leak detector (LD). After roughly 5% of the surface was inspected in this way, a leak of $>10^{-5}$ mbar xL/s was discovered and localized to an area of 5 by 5 cm. Dye penetrant applied to this area disclosed three pinholes. Two small slag pockets were discovered while these points were being ground out. After these were rewelded, no further leakage could be found in the repaired area. Global leak rates measured after the machine was reevacuated indicated that this leak was about 30% of the overall leak rate. 1 ref., 5 figs., 1 tab.

38141 (CONF-891007–Vol.2, pp. 983-986) **Compact Ignition Tokamak, vacuum vessel, design and development.** Reddan, W.G. (Ebasco Services Inc., Princeton, NJ (USA)); Warren, J.G. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Compact Ignition Tokamak (CIT) is an experimental device that is expected to reach ignition. The CIT vacuum vessel is being designed for a base pressure of no greater than 10^{-7} torr and a temperature of 350°C. It must be capable of withstanding plasma disruptions and mechanical loads imposed by other components. This paper describes the design status and salient features of the vacuum vessel as well as near term plans for testing and prototype development. 5 refs., 6 figs., 1 tab.

38142 (CONF-891007–Vol.2, pp. 987-990) **Beam current regulation of DIII-D neutral beam long pulse ion sources.** Hong, R. (General Atomics, San Diego, CA (USA)); Kellman, D.; Santamaria, G.; Colleraine, A.; Kim, J.; Lee, R.; Phillips, J.; Wight, J. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC03-89ER51114. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

An intrinsic characteristic of the neutral beam long pulse ion source installed on the DIII-D tokamak is the slow increase of arc and beam currents during the beam pulse. This ramping is attributed to the heating of the filaments by energetic electrons backstreaming from the accelerator into the arc chamber. The corresponding change in beam perveance causes the beam optics to vary during a beam pulse, often resulting in an overdense condition. A technique which employs the idea of compensating the filament temperature rise by stepping down the voltage applied to the filaments at beam turn-on has proved to be somewhat effective and successful in regulating the beam current. The disadvantage of this technique is that the amount of filament voltage step-down varies from source to source and is dependent on beam energy. A new technique uses a Langmuir probe signal for feedback regulation in the arc power supply. Plasma density within the arc chamber is maintained at a constant value, as is beam current. This arc regulation method also features arc notching at beam turn-on to provide perveance matching during initial beam formation, which is crucial to obtaining smooth initial beam extraction, a high perveance beam, and thus higher power beam operation. The beam power achieved with this arc notching and regulation technique is about 10% higher than that obtained previously with the filament voltage step-down method. 2 refs., 12 figs., 1 tab.

38143 (CONF-891007–Vol.2, pp. 991-995) **Neutral injection for TEXTOR.** Euringer, H. (Institut fuer PlasmaPhysik, Kernforschungsanlage Juelich (West Germany)); Lochter, M.; Pfister, U.; Uhlemann, R. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Two neutral beam lines have been built for co- and counter-injection into TEXTOR. The rated data for one beam line are 55 kV, 88 A (i.e. 4.8 MW) over 10 sec for H2. The neutral injectors employ cooled galvano-grids, cryopumps, and new solutions for the beam-dumps and power supplies. These components are described in detail and the measuring methods for the beam quality and the results are given as well as some results of TEXTOR during neutral beam injection. 8 refs., 12 figs., 2 tabs.

38144 (CONF-891007–Vol.2, pp. 996-999) **Operation of JT-60NBI and NBI system for JT-60 upgrade.** Kuriyama, M.; Akiba, M.; Akino, N.; Dairaku, M.; Ebisawa, N.; Hiruta, K.; Kawai, M.; Kitamura, S.; Kikuchi, K.; Komata, M. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The JT-60 neutral beam injector has successfully been operated for three years, delivering the neutral beam power of 20 MW at the beam energy of 75 keV. Recent plasma heating experiments required a higher beam power rather than a higher beam energy. The accelerator grid gap spacing were shortened to get higher beam current and hence to get a higher beam power at the moderate beam energy range of around 70 keV. The ion beam current could be increased from the original value of 35 A to 48 A at the same beam energy of 75 keV. The maximum injection power achieved was 26 MW, which is 30% higher than the original rated power. The helium beam injection into JT-60 was performed for investigating fusion alpha particles exhaustion from the plasma. The helium ion beam current extracted from ion sources was 40 - 45 A at the energy of 31 keV. The injection power was about 0.4 MW. In the helium beam operation, the helium gas in the beamline chamber was pumped out by SF6 gas condensed cryo-sorption pump. The pumping speed of about 600 m^3/s for helium gas has been obtained successfully. The JT-60 neutral beam injector will be modified to inject 120 keV deuterium beam into JT-60 Upgrade, which will be started to operate at the beginning of 1991. Furthermore, four beamline units out of 14 units will be modified from original perpendicular injection to tangential one. These four units are combined into two newly designed beamline boxes, but the most of the beamline components in the original units are applied to the tangential neutral beam injector system. 5 refs., 8 figs.

38145 (CONF-891007–Vol.2, pp. 909-912) **Vertical stability requirements for ARIES-1 reactor.** Bathke, C.G. (Los Alamos National Lab., NM (USA)); Jardin, S.C.; Ward, D.J.; Leuer, J.A. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The vertical stability of the ARIES-I reactor design is analyzed with the NOVA-W, PSTAB, and TSC codes. A growth rate of ~ 5.7 s^{-1} is predicted for a vacuum vessel positioned behind the scrape-off, first wall, and blanket (0.7-m inboard and 0.9-m outboard thickness) and acting as a passive stabilizer. A reactive power of $\sim$ 2 MVA would be required for active feedback coils located outside of the TF coils ($\sim$ 3 m beyond the plasma in the equational plane) to correct a 50-mm vertical displacement of the magnetic axis. A multipole-expansion technique used in the TSC analysis is also used to examine options that minimize stored energy. 10 refs., 8 figs., 2 tabs.

38146 (CONF-891007–Vol.2, pp. 905-908) **Plasma vertical stability and feedback control for CIT.** Kessel, C.E. (Princeton Univ., NJ (USA)); Jardin, S.C.; Weiner, R. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The plasma vertical stability and vertical position feedback control are examined for the Compact Ignition Tokamak. The Tokamak

Simulation Code [1] is used to determine the plasma growth times in the absence of control, and to simulate feedback control with realistic features to determine the requirements on the internal control coils and their power supplies. 6 refs., 7 figs.

38147 (CONF-891007–Vol.2, pp. 937-940) **Alignment of the TFTR bumper limiter.** Barnes, G.W. (Princeton Univ., NJ (USA)); Owens, D.K.; Loesser, G.D.; Ulrickson, M. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The TFTR Bumper Limiter (BL) is an axisymmetric toroidal limiter mounted on the inner wall of the vacuum vessel. It subtends 120° poloidally and has a surface area of 22 m^2. The plasma facing surface consists of 1,000 kg of graphite tiles mounted on watercooled Inconel backing plates. During the initial installation in the Spring of 1985, the limiter surface was aligned to the toroidal magnetic field by mechanical and magnetic measurements to an estimated accuracy of ±2 mm. During subsequent operation, especially in the 1988 run period in which 30 MW of Neutral Beam Injection routinely occurred, several tiles at points on the limiter which protruded slightly into the plasma were severely damaged. The damage, cracked and spalled tiles, is believed to be initiated by high energy disruptions and aggravated by normal high power operation. The damage pattern and temperature rise during normal operation are consistent with this interpretation. A vacuum vessel opening to replace the damaged tiles and realign the limiter was required. The bumper limiter was reshaped to be circular to ±0.5 mm at the midplane by means of mechanical measurements in order to better distribute the heat loads and eliminate hot spots. The ±0.5 mm accuracy is determined by the variation in individual tile thickness which is ±0.5 mm. This paper describes the methods used to mechanically align the limiter and presents evidence based on machine operation with plasma that the limiter is reasonably well aligned with the toroidal field. Future work dealing with the alignment of the total limiter to the toroidal field using mechanical and magnetic measurements and the replacement of a subset of the carbon tiles with carbon-carbon composite material is also discussed. 7 refs., 4 figs.

38148 (CONF-891007–Vol.2, pp. 941-946) **Modeling of runaway electron damage for the design of tokamak plasma facing components.** Niemer, K.A. (North Carolina State Univ., Raleigh (USA)); Gilligan, J.G.; Croesmann, C.D.; Bolt, H.H. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC04-76DP00789. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Cracking, craters, spotty damage (discoloration), and missing chunks of material have been observed on limiters and along the midplane of tokamak inner walls. This damage is assumed to be due to runaway electron discharges. These runaway electrons have been predicted to range in energy from a few MeV to several hundred MeV. The energy density from the runaway electron discharges range from 10 to 500 MJ/m^2 over pulse lengths of 5 to 50 msec. The PTA code package is a three dimensional, time dependent, computational code package used to predict energy deposition, temperature rise, and damage on tokamak first wall and limiter materials from runaway electron impact. Two experiments were modeled to validate the PTA code package. The first experiment tested the thermal and structural response from high energy electron impact on different fusion materials, and the second experiment simulated runaway electrons scattering through a plasma facing surface (graphite) into an internal structure (copper). The PTA calculations compared favorably with the experimental results. In particular, the PTA models identified gap conductance, thermal contact, x-ray generation in materials, and the placement of high stopping power materials as key factors in the design of plasma facing components, resistant to runaway electron damage. 9 refs., 7 figs., 1 tab.

38149 (CONF-891007–Vol.2, pp. 1000-1003) **Assessment of possible implications of a neutral beam configuration for CIT.** Grisham, L.R. (Princeton Univ., NJ (USA)); Cooper, W.S.; Purgalis, P.; Brown, T. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC03-76SF00098. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The present plans for the Compact Ignition Tokamak (CIT) call for the auxiliary heating to be done by RF techniques. However, Goldston has proposed [1] that an alternative scenario might involve running TFTR type supershot plasmas with peaked density profiles. This would require central fueling by deuterium and tritium beams. The authors have performed a conceptual study of a system to inject negative ion based 300 keV beams of D and T using the available port geometry. They report on the resulting conceptual design, the tritium usage during operation, and the implications for the test cell configuration. 3 refs.

38150 (CONF-891007–Vol.2, pp. 1007-1018) **Present status of the Large Helical Device project.** Iiyoshi, Atsuo (National Institute for Fusion Science, Nagoya (Japan)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Present status of the Large Helical Device (LHD) project is reported. The LHD device is a Heliotron/Torsatron type superconducting machine, which is scheduled to be constructed by newly established National Institute for Fusion Science as the major joint-university fusion research project in Japan. The basic design parameters of the device are 1 (poloidal pitch number of the helical coil)=2, m (toroidal pitch number)=10, B (toroidal magnetic field) = 4T, R (major radius) = 4m and a_c(coil minor radius)=0.5-0.6m. The total stored magnetic energy is ~ 2GJ. The heating power, P_{abs}, (absorbed power in the plasma) is 20MW. Physical objective of this project is to produce currentless steady state high temperature plasmas and conduct various experimental programs to develop helical fusion system as an alternative approach of tokamak. 24 figs., 8 tabs.

38151 (CONF-891007–Vol.2, pp. 1021-1026) **The ARIES tokamak fusion reactor study.** Bartlit, J.R. (Los Alamos National Lab., NM (USA)); Bathke, C.G.; Krakowski, R.A.; Miller, R.L.; Beecraft, W.R.; Hogan, J.T.; Peng, Y.K.M.; Reid, R.L.; Strickler, D.J.; Whitson, J.C. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The ARIES study is a community effort to develop several visions of the tokamak as fusion power reactors. The aims are to determine their potential economics, safety, and environmental features and to identify physics and technology areas with the highest leverage for achieving the best tokamak reactor. Three ARIES visions are planned, each having a different degree of extrapolation from the present data base in physics and technology. The ARIES-I design assumes a minimum extrapolation from current tokamak physics (e.g., 1st stability) and incorporates technological advances that can be available in the next 20 to 30 years. ARIES-II is a DT-burning tokamak in 2nd stability regime and employs both potential advances in the physics and expected advances in technology and engineering; and ARIES-III is a conceptual D^3He reactor. This paper focuses on the ARIES-I design. Parametric systems studies show that the optimum 1st stability tokamak has relatively low plasma current (~ 12 MA), high plasma aspect ratio (~ 4-6), and high magnetic field (~ 24 T at the coil). ARIES-I is 1,000 MWe (net) reactor with a plasma major radius of 6.5 m, a minor radius of 1.4 m, a neutron wall loading of about 2.8 MW/m^2, and a mass power density of about 90 kWe/ton. The ARIES-I reactor operates

at steady state using ICRF fast waves to drive current in the plasma core and lower-hybrid waves for edge-plasma current drive. The current-drive system supplements a significant (~ 57%) bootstrap current contribution. The impurity control system is based on high-recycling poloidal divertors. Because of the high field and large Lorentz forces in the toroidal-field magnets, innovative approaches with high-strength materials and support structures are used. 24 refs., 4 figs., 1 tab.

38152 (CONF-891007–Vol.2, pp. 1027-1030) **The ARIES-I high-field-tokamak reactor: Design-point determination and parametric studies.** Miller, R.L. (Los Alamos National Lab., NM (USA)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The multi-institutional ARIES study has examined the physics, technology, safety, and economic issues associated with the conceptual design of a tokamak magnetic-fusion reactor. The ARIES-I variant envisions a DT-fueled device based on advanced superconducting coil, blanket, and power-conversion technologies and a modest extrapolation of existing tokamak physics. A comprehensive systems and trade study has been conducted as an integral and ongoing part of the reactor assessment in order to identify an acceptable design point to be subjected to detailed analysis and integration as well as to characterize the ARIES-I operating space. Results of parametric studies leading to the identification of such a design point are presented. 16 refs., 6 figs., 2 tabs.

38153 (CONF-891007–Vol.2, pp. 1031-1034) **Design integration of the ARIES-I tokamak reactor.** Sze, D.K. (Argonne National Lab., IL (USA)); Creedon, R.L.; Wong, C.P.C.; Peng, Y.K.M.; Miller, R.L.; Bromberg, L. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

ARIES-I is a 1,000 MWe commercial tokamak reactor design based on minimal extrapolation of present-day physics and expected technological development in the next 30 years, such as high-field, superconducting magnets and low-activation silicon carbide composite materials. This paper summarizes the design integration of the fusion-power core and the reactor subsystems. Consideration has been given to such details as support of the toroidal field coils, divertor module access, blanket access, design and support of the RF antennas, location of the primary vacuum and cryostat vacuum boundaries. The maintenance procedure being considered for ARIES-I is a modular approach. With this type of maintenance, a module consisting of the first-wall, blanket, shield, divertor module, and toroidal field coil is replaced as a single unit at the end-of-life of the module. Rapid replacement of the irradiated FPC components is expected. Should the first-wall or blanket fail before the end of its design lifetime, in-situ repair and replacement schemes are proposed for blanket sub-modules. Replacement of the divertor plate assemblies is simplified by providing a direct access path through which damaged plates can be removed and new plates installed without interfering with the other FPC components. 7 refs., 3 figs., 2 tabs.

38154 (CONF-891007–Vol.2, pp. 1035-1038) **Blanket design for the ARIES-I tokamak reactor.** Wong, C.P.C. (General Atomics, San Diego, CA (USA)); Cheng, E.T.; Creedon, R.L.; Leuer, J.A.; Schultz, K.R.; Grotz, S.P.; Ghoniem, N.M.; Hasan, M.Z.; Martin, R.C.; Najmabadi, F. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC03-89ER52153. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

For the ARIES-I tokamak power reactor design, the authors evaluated two gas-cooled, low-activation ceramic blanket designs, a 5 MPa helium-cooled design, and a 0.5 MPa CO_2 gas carried Li_4SiO_4 particulate design. The more extensive data base available for the helium-cooled option has led to the selection of this option as their reference design. The selected ARIES-I blanket design uses SiC composite as the structural material, 5 MPa helium as the coolant, Li_4SiO_4 as the solid tritium breeder, and Be metal pellets as the neutron multiplier. This combination of materials provides the design of a high nuclear performance blanket with high outlet temperature, good neutron multiplication, and adequate tritium breeding. It is a low-activation design that satisfies the criteria for 10CFR61 Class-C shallow land waste disposal and achieves inherent safety since it produces negligible afterheat, thus virtually eliminating the possibility of radioactivity release to the public. 14 refs., 1 fig., 2 tabs.

38155 (CONF-891007–Vol.2, pp. 1039-1042) **Energy conversion options for ARIES-III - A conceptual D-^{3}He tokamak reactor.** Santarius, J.F. (Univ. of Wisconsin, Madison (USA)); Blanchard, J.P.; Emmert, G.A.; Sviatoslavsky, I.N.; Wittenberg, L.J.; Ghoneim, N.M.; Hasan, M.Z.; Mau, T.K.; Greenspan, E.; Herring, J.S. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The potential for highly efficient conversion of fusion power to electricity provides one motivation for investigating D-^{3}He fusion reactors. This stems from: (1) the large fraction of D-^{3}He power produced in the forms of charged particles and synchrotron radiation which are amenable to direct conversion, and (2) the low neutron fluence and lack of tritium breeding constraints, which increase design flexibility. The design team for a conceptual D-^{3}He tokamak reactor, ARIES-III, has investigated numerous energy conversion options at a scoping level in attempting to realize high efficiency. The energy conversion systems have been studied in the context of their use on one or more of three versions of a D-^{3}He tokamak: a first stability regime device, a second stability regime device, and a spherical torus. The set of energy conversion options investigated includes bootstrap current conversion, compression-expansion cycles, direct electrodynamic conversion, electrostatic direct conversion, internal electric generator, liquid metal heat engine blanket, liquid metal MHD, plasma MHD, radiation boiler, scrape-off layer thermoelectric, synchrotron radiation conversion by rectennas, synchrotron radiation conversion by thermal cycles, thermionic/AMTEC/thermal systems, and traveling wave conversion. The original set of options is briefly discussed, and those selected for further study are described in more detail. The four selected are liquid metal MHD, plasma MHD, rectenna conversion, and direct electrodynamic conversion. Thermionic energy conversion is being considered, and some options may require a thermal cycle in parallel or series. 17 refs., 3 figs., 1 tab.

38156 (CONF-891007–Vol.2, pp. 1055-1058) **Confinement physics research facility/ZTH: A progress report.** Hammer, C.F. (Los Alamos National Lab., NM (USA)); Thullen, P. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

In October 1985 the Los Alamos National Laboratory's Controlled Thermonuclear Research (CTR) Division began the design and construction of the Confinement Physics Research Facility (CPRF) and the ZTH toroidal, reversed-field-pinch (RFP), Plasma Physics experiment. The CPRF is a facility which will provide the buildings, utilities, pulsed power system, control system and diagnostics needed to operate a magnetically confined fusion experiment, and ZTH will be the first experiment operated in the facility. The construction of CPRF/ZTH is scheduled for completion in the first quarter of 1993. 5 figs.

38157 (CONF-891007–Vol.2, pp. 1059-1063) **Advanced wall reversed field pinch.** Newton, A.A. (Culham Lab., Abingdon, (England)); Booth, J.A.; Hall, R.K.; Peacock, R. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion

engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

For the next step in the investigation of Reversed Field Pinches the authors are converting the HBTX machine to have an advanced first wall with a low Z smooth surface and a close fitting thick conducting shell. The new wall is the logical extrapolation of previous work where the loop voltage has been reduced about five fold by lowering field errors, improving the equilibrium and removing the limiters. These steps reduce the magnetic flux intersecting the wall and the advanced first wall will further reduce this flux by suppressing magnetic fluctuations. The paper describes the engineering design and construction of the new experiment. 12 refs., 6 figs., 2 tabs.

38158 (CONF-891007–Vol.2, pp. 1072-1075) **JT-60 operational experience and trouble analysis.** Arakawa, K. (Japan Atomic Energy Research Institute, Ibaraki (Japan)); Shimizu, M.; Seimiya, M.; Kimura, T.; Shirakata, H. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Operational experience is reported of JT-60 from FY 1985 to FY 1988. Various statistics and trouble analyses gave us useful information on the availability and reliability of the JT-60 facilities. Some effective countermeasures have been developed to raise the operational efficiency. 9 refs., 8 figs., 3 tabs.

38159 (CONF-891007–Vol.2, pp. 1076-1079) **Systems integration approach to developing component arrangements, the test facility, and maintenance for the Compact Ignition Tokamak.** Spampinato, P.T. (Princeton Univ., NJ (USA)); Brown, T.G.; Mueller, J. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A systems integration approach for developing the Compact Ignition Tokamak is providing total integration of the machine and facilities. In particular, it is ensuring that the test cell design accommodates all component arrangements envisioned during the machine lifetime, that maintenance operations can be accomplished with available equipment, and that a degree of operating flexibility is factored into the overall configuration. The Systems Integration Group has defined machine component interfaces, established maintenance requirements, and coordinated appropriate facility changes. A facility arrangement has been developed that allows personnel access into the diagnostic cells, the high bay, and the basement, and provides for remote maintenance in the center cell where the machine core is located. The center cell arrangement is based on installing up to seven midplane heating systems, an array of diagnostics, and an articulated boom manipulator for in-vessel remote maintenance operations. 7 figs.

38160 (CONF-891007–Vol.2, pp. 1089-1091) **The 8 MW, 8 GHz FTU LHRH system: R and D and design status.** Andreani, R. (Associazione EURATOM-ENEA sulla Fusione, Rome (Italy)); Gourlan, C.; Mirizzi, F.; Sassi, M.; Ferro, C.; Marra, A.; Orsini, A.; Fortunato, T.; Roccon, M. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Plasma heating of the Frascati Tokamak Upgrade will be sought by means of a Lower Hybrid, electron mode, additional heating system, rated for a pulsed (1 s pulse length) RF power up to 8 MW at a frequency of 8 GHz. Expressly developed gyrotrons will be used as RF power generators; two different prototypes are presently under test. A low attenuation transmission system, using overmoded waveguides, will feed the coupling structures. A fully reviewed design of the RF coupling structures has been recently developed on the basis of the previous experience of the Frascati laboratories RF group in similar structures. Most of the critical part of the RF system have already been tested with promising results. 4 refs., 2 figs., 3 tabs.

38161 (CONF-891007–Vol.2, pp. 1092-1095) **Microwave transport system for the MTX.** Felker, B. (Lawrence Livermore National Lab., CA (USA)); Ferguson, S.W. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract W-7405-ENG-48. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

This paper presents the design and construction, as well as the initial operation, of the Microwave Transmission System. The system consists of containment vessels, mirror boxes, mirrors, an alignment system, two turbo-molecular pump vacuum stations, and microwave source. Fifty-ns-length pulses of 6-MeV electrons pass through a free electron laser (FEL) wiggler. A 300 W extended interaction oscillator (EIO) of 140 GHz frequency supplies the seed signal for amplification in the wiggler. The electron beam is dumped and the microwave beam is transmitted quasi-optically 90 ft by six aluminum mirrors through an evacuated tube. Three of the mirrors are elliptical paraboloids and the others are flat. A seventh mirror is rotated into the microwave beam to divert it into a load tank. The transport vacuum vessel is 20-in.-diameter stainless steel tube with bellows and mirror boxes at each mirror. Two vacuum systems at each end of the transport tube allow a base pressure of 10^{-7} Torr to be attained by 7000 L/s of turbo-molecular pumping. Also at each mirror, at the MTX vessel, and at the two ends of the wiggler waveguide are HeNe laser detectors used for vacuum alignment. Descriptions of the major components, their requirements and system requirements will be presented, and the initial operation of the system and its performance will be described. 7 figs., 2 tabs.

38162 (CONF-891007–Vol.2, pp. 1096-1099) **Effects of beam perveance to the performance characteristics of the electrically electron-suppressed beam direct converter with secondary electron suppressor grids.** Yamamoto, Yasushi (Kyoto Univ. (Japan)); Yoshikawa, Kiyoshi; Toku, Hisayuki; Haga, Tsuneyuki; Noma, Takashi. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

To see the effects of the beam perveance to performance characteristics of the beam direct energy converter (BDC) with secondary electron suppressor grids and examine the validity of the BDC design, the helium beams of various energies and currents from 15 keV, 60 mA up to 20 keV, 250 mA were injected to the BDC, which had shown already excellent energy recovery performances for one specific beam parameter of 15.4 keV, 90 mA, He^+ beam with relatively high pressure of 10-2 Pa. Current recovery efficiency is found to have the maximum near the designed perveance, and to show similar dependence on the perveance for 15 and 20 keV beams when collectors are at grounded potential as is predicted from theory. With increase of collector potentials, however, there seems to increase some small discrepancy in the efficiency between 15 and 20 keV. Net energy recovery efficiencies in the experiments have shown that they are almost constant in the perveance region below the designed, and then begin to decrease with increase of beam perveance. It is found eventually that the beam perveance is a good parameter in evaluation of the performance characteristic of the BDC rather than beam energy and current. The design of the BDC is also found to be suitable. 10 refs., 8 figs., 1 tab.

38163 (CONF-891007–Vol.2, pp. 1043-1046) **Apollo-L2, an advanced fuel tokamak reactor utilizing direct conversion.** Emmert, G.A. (Univ. of Wisconsin, Madison (USA)); Kulcinski, G.L.; Blanchard, J.P.; El-Guebaly, L.A.; Khater, H.Y.; Santarius, J.F.; Sawan, M.E.; Sviatoslavsky, I.N.; Wittenberg, L.J.; Witt, R.J. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium

on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A scoping study of a tokamak reactor fueled by a D-^{3}He plasma is presented. The Apollo D-^{3}He tokamak capitalizes on recent advances in high field magnets (20 T) and utilizes rectennas to convert the synchrotron radiation directly to electricity. The low neutron wall loading (0.1 MW/m^2) permits a first wall lasting the life of the plant and enables the reactor to be classified as inherently safe. The cost of electricity is less than that from a similar power level DT reactor. 10 refs., 1 fig., 4 tabs.

38164 (CONF-891007–Vol.2, pp. 1049-1054) **Present status of JT-60 upgrade.** Horiike, H. (Japan Atomic Energy Research Institute, Ibaraki (Japan)); Ando, T.; Horie, T.; Kushima, T.; Koizumi, K.; Matsukawa, M.; Neyatani, Y.; Ninomiya, H.; Shimizu, M.; Yamamoto, M. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The JT-60 tokamak will be modified wherein the original outer-single null plasma containment vacuum vessel and poloidal field coils, are exchanged with those of large dee-shaped cross sections. The basic dimensions of the new vessel will allow plasmas of 6 MA current, 70 to 100m^3 volume and vertical elongations of 1.4 to 1.7. Installation of a large vessel is made possible at the cost of high toroidal ripple volume where plasma occupies and high electromagnetic force acting on the coils and the vessel. A driving requirement to the modification is maximization of the plasma performance with minimum expense, and the access to the plasma for heatings and diagnostics. The plasma configuration is designed to allow largest dee shape discharge with lower single null, within the boundary of the original toroidal field coils. The dee shaped vessel is designed along a new concept of Inconel 625 all welded continuous chamber in a double skin construction. Rectangular tubes are sandwiched by three dimensionally curved skins to form a everywhere round vacuum vessel. Change of the gas to deuterium from hydrogen is being prepared in JT-60 upgrade and will also enable neutral beams of 40MW. Systems of LHRF and ICRF will be provided with larger antennas. 10 refs., 8 figs., 2 tabs.

38165 (CONF-891007–Vol.2, pp. 1064-1067) **Microwave Tokamak Experiment: An overview of the construction and checkout phase.** Lang, D.D. (Lawrence Livermore National Lab., CA (USA)); Bell, H.H. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

At Lawrence Livermore National Laboratory (LLNL) the authors constructed and presently operate the Microwave Tokamak Experiment (MTX) to demonstrate the feasibility of using microwave pulses produced from a free electron laser (FEL) to provide electron cyclotron heating (ECH) for use in tokamaks, particularly high-field machines. The MTX consists primarily of the ALCATOR C tokamak and power supplies that were documented and disassembled at the Massachusetts Institute of Technology (MIT) and shipped to LLNL in April 1987. They made many additions, including a new primary power system from the Magnetic Fusion Test Facility (MFTF) substation, a new commutation system, a substantially upgraded seismic support system for earthquake loading, a fast controls system for use with the FEL, a new data-acquisition system, and a new vault facility. They checked out these systems and put them into operation in October 1988; they achieved the first plasma in November 1988. They have also constructed and installed the microwave transmission system and the local microwave system to be used with the FEL. These systems transmit the microwaves to MTX quasi-optically through an evacuated tube. The ongoing plasma operations, both with and without FEL heating, are described in a companion paper. 12 refs., 2 figs., 2 tabs.

38166 (CONF-891007–Vol.2, pp. 1068-1071) **Microwave Tokamak Experiment (MTX) first year of operation and future plans.** Jackson, M.C. (Lawrence Livermore National Lab., CA (USA)). Oak Ridge National Lab., TN (USA). [1989]. DOE Contract W-7405-ENG-48. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Microwave Tokamak Experiment (MTX) at Lawrence Livermore National Laboratory (LLNL) began plasma operations in November 1988, and the authors main goal is the study of electron cyclotron heating (ECH) in plasma discharges. The MTX tokamak was relocated from the Massachusetts Institute of Technology (MIT), and they have re-created plasma parameters that are similar to those generated while the tokamak was at MIT. After stable ohmic operation was achieved, single-pulse FEL heating experiments began. During this phase, the FEL operated at low power levels on the way to its ultimate goal of 2 GW and 140 GHz with a 30-ns pulse length. They have developed a number of new diagnostics to measure these fast FEL pulses and the resulting plasma effects. In this paper, they present results that show the correlation of MTX data with MIT data, some of the operational modifications and procedures used, results to date from preliminary tokamak operations with the FEL, and our near term operational plans.

38167 (CONF-891007–Vol.2, pp. 1083-1088) **The 15 MW microwave generator and launcher of the lower hybrid current drive experiment on JET.** Pain, M.; Brinkschulte, H.; Bosia, G.; Brusati, M.; Dobbing, J.A.; Ekedahl, A.; Gammelin, M.; Gormezano, C.; Idelon, C.; Jacquinot, J. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The lower hybrid current drive experiment on JET, aimed at generating current in the plasma by launching a wave at 3.7 GHz into the torus, required the building of a large high power microwave generator and antenna. The generator can provide 15 MW for 10 seconds or 12 MW for 20 seconds. This power will be fed to a phased-array antenna consisting of 48 stainless steel modules assembled in an array of 384 waveguides. The antenna position will be controlled in real time in order to optimize the coupling to the plasma. The phasing between different modules can be set so as to vary the N//between 1.8 and 2.4. 4 refs., 5 figs., 1 tab.

38168 (CONF-891007–Vol.2, pp. 1103-1107) **Identification and selection of initiating events for experimental fusion facilities.** Cadwallader, L.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC07-76ID01570. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

This paper describes the current approaches used in probabilistic risk assessment (PRA) to identify and select accident initiating events for study in either probabilistic safety analysis or PRA. Current methods directly apply to fusion facilities as well as other types of industries, such as chemical processing and nuclear fission. These identification and selection methods include the Master Logic Diagram, historical document review, system level Failure Modes and Effects Analysis, and others. A combination of the historical document review, such as Safety Analysis Reports and fusion safety studies, and the Master Logic Diagram with appropriate quality assurance reviews, is suggested for standardizing U.S. fusion PRA efforts. A preliminary set of generalized initiating events applicable to fusion facilities derived from safety document review is presented as a framework to start from for the historical document review and Master Logic Diagram approach. Fusion designers should find this list useful for their design reviews. 29 refs., 1 tab.

38169 (CONF-891007–Vol.2, pp. 1108-1111) **Risk evaluation of the in-vessel plant area of a net type tokamak machine: Direct, induced and common cause failures.** Boschi, A.

(ENEA/DISP, Rome (Italy)); Palma, T.; Sarto, S.; Cambi, G.; Cavallone, G.; Zappellini, G. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

This paper describes an approach to the quantitative risk assessment of the plant area of a NET type tokamak composed by the in-vessel systems (First Wall, Divertor, Driver Blanket and Torus Vessel) and their primary cooling circuits. Contribution to the overall risk from both Direct Failures (developing inside each single system) and Induced Failures (propagating from one system to another through their interfaces) have been taken into account. Common cause failures associated with Plant Auxiliary Systems (as Machine Power Supply and Control) have been also considered. The Functional Analysis developed for the NET plant has been utilized to identify the functional interfaces between different systems. The key tools of the analysis are Functional Fault Trees and Event Trees, each of them having a loss of process function as Top Event or Initiating Event, respectively. Contributions from Induced and Common Cause Failures have been taken into account by modifying, for each Event Tree, the probability evaluation of the Initiating Event based on the Direct Failures, only. The effect of the Initiating Events on Safety Functions have been considered assigning conditional probabilities to the related Safety Systems. The results of the analysis provide for a risk evaluation in terms of probabilities versus consequences; they are to be compared with the assumed safety design targets and with the results obtained by the Direct Failures Safety Assessment concerning the same Systems. 11 refs., 4 figs., 1 tab.

38170 (CONF-891007–Vol.2, pp. 1112-1115) **An estimation of radiological hazards of current tokamak reactor concepts.** Ho, S.K. (Univ. of California, Berkeley (USA)). Oak Ridge National Lab., TN (USA). [1989]. DOE Contract FG03-89ER52154. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The potential radiological hazards of current fusion reactor designs is investigated. Their studies of the ARIES-type tokamak reactor design candidate indicate favorable environmental and safety performance in comparison to the fission reactors and fusion reactor designs in the ESECOM report. 6 refs., 6 figs., 5 tabs.

38171 (CONF-891007–Vol.2, pp. 1116-1119) **Activation evaluation of fusion solid breeder materials.** Cheng, E.T. (General Atomics, San Diego, CA (USA)); Schultz, K.R.; Wong, C.P.C. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC03-89ER52153. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Solid lithium ceramic compounds are considered prime candidate breeder materials for D-T based fusion reactors because of potential advantages in safety, lack of electromagnetic effects, and relative ease of tritium extraction. Li_2O, Li_4SiO_4, $LiAlO_2$, and Li_2ZrO_3 are among the most plausible candidate solid breeder materials. Studies were performed of these materials to compare their activation characteristics after neutron exposure in a fusion reactor, including quantities relevant to safety and waste disposal. Induced radioactivity, decay heat, biological dose rate, and waste disposal rating of these materials were considered. Impurity elements that appear in lithium such as Na, K and Ca, were also included in the analysis. The results show that Li_2ZrO_3 gives the highest values in every aspect of activation concerns except waste disposal, where $LiAlO_2$ dominates. $LiAlO_2$ and Li_2ZrO_3 will qualify for 10CFR61 low level waste disposal only when these materials are located in the lower neutron fluence region in the blanket. Li_2O and Li_4SiO_4 show much lower (at least 3 orders of magnitude) induced activity than Li_2ZrO_3 and $LiAlO_2$ and satisfy all aspects of low activation considerations. 7 refs., 7 tabs.

38172 (CONF-891007–Vol.2, pp. 1125-1128) **A mass transport model for hydrogen generation during lithium-lead/water interactions.** Biney, P.O. (Mechanical Engineering Dept., Prairie View, TX (USA)); Lomperski, S.; Coradini, M.L.; Krueger, J. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A mass transport chemical reaction model is presented to predict the rate of hydrogen generated in the interaction of lithium-lead alloy ($Li_{17}Pb_{83}$) with water. This model makes use of experimental data to determine the rate of hydrogen generation from such an interaction. The model is used to determine diffusion rate constants for the lithium-lead/water interaction. The results from the model indicate that the chemical reaction can be represented by a linear rate law, for the later times of the reaction (> 10 s). However, the early stage of the chemical reaction does not follow a linear rate law. The results also indicate that for initial liquid metal temperatures below 590°C, the activation energy is not a function of the initial liquid metal temperature. 8 refs., 6 figs.

38173 (CONF-891007–Vol.2, pp. 1129-1133) **Behavior of radioactive species during water injection into alloy breeder material.** Jeppson, D.W. (Westinghouse Hanford Co., Richland, WA (USA)); Serinni, G. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A fusion safety experiment was conducted to determine the consequences of water injection into lead-lithium alloy under postulated reactor accident conditions. The fraction of water reacted, quantity of hydrogen produced, and behavior of radioactive species associated with the use of this alloy as a breeder material were determined. The reaction products were identified, and the aerosol was characterized for particle size, chemical composition, and deposition rate. 2 refs., 3 figs., 7 tabs.

38174 (CONF-891007–Vol.2, pp. 1134-1137) **Program CICC, flow and heat transfer in cable in conduit conductors (CICC).** Wong, R.L. (Lawrence Livermore National Lab., CA (USA)). Oak Ridge National Lab., TN (USA). [1989]. DOE Contract W-7405-ENG-48. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Computer program CICC (cable in conduit conductors) has been written for use in the thermo-fluids design of superconducting magnets for tokamak reactors, which use forced-flow, helium-cooled, cable-in-conduit conductors (CICC). In addition to background heat loads that vary with space and time, these superconductors can develop normal zones that generate electrical resistance heat. Program CICC models the transient thermodynamic and fluid-dynamic system response to background heating and normal-zone propagation in the superconductor. The computational algorithm described in this paper couples a one dimensional, compressible pipe-flow model (including flow choking) with two-dimensional, axisymmetric heat conduction models of the superconductor cable, the conduit, and the epoxy-conduit insulation. National Institute of Standards and Technology helium properties are used. The model is verified by comparison with measured temperature and pressure profiles from thermal expulsion experiments. 10 refs., 9 figs.

38175 (CONF-891007–Vol.2, pp. 1138-1141) **Electromechanical analysis of a prototype 20 TESLA, single turn toroidal field coil for IGNITEX.** Hsieh, K.T. (Univ. of Texas, Austin (USA)); Driga, M.D.; Weldon, W.F.; Werst, M.D. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The fusion ignition experiment (IGNITEX) device is a single turn coil tokamak designed to produce and control an ignited plasma using ohmic heating alone. The proposed high strength toroidal field (TF) magnet operates at a magnetic field on axis of 20 T, using homopolar generators (HPGs). In this paper, the electromechanical analysis of a scaled down prototype (0.06 scale in linear dimensions) of the IGNITEX TF magnet is presented. The objective of the Ignition Technology, Demonstration (ITD) program is to design, build, and test the operation of a single turn, 20 T, TF coil, powered by an existing: HPG power supply system. Unlike conventional TF coils that use: multiple turns of the conductor, the single turn coil eliminates the need for turn-to-turn insulation; therefore, better utilizing the available area for stress and thermal management. Precooling of the coil to liquid-nitrogen temperature permits the magnet to operate in a wider temperature regime without exceeding material properties. Scaling relationships presented in this paper show that temperatures and stresses of a scaled-down coil and their relative distribution will approximate predicted levels of the full-scale IGNITEX device. A finite element program (TEXCOR) which solves a set of coupled electrical circuit, magnetic diffusion, and thermal diffusion equations with temperature dependent properties was developed. TEXCOR provides temperatures and magnetic body force densities for stress analysis of the magnet structure. The effect of flatness tolerance stackups in the TF coil assembly is discussed and methods to characterize and minimize the negative effect of nonideal conditions are given. Generator fault scenarios are also addressed. 5 refs., 8 figs., 1 tab.

38176 (CONF-891007–Vol.2, pp. 1142-1143) **A code for calculating force and temperature of a bitter plate type toroidal field coil system.** Christensen, U. (Princeton Univ., NJ (USA)). Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

To assist the design effort of the TF coils for CIT, a set of programs was developed to calculate the transient spatial distribution of the current density, the temperature and the forces in the TF coil conductor region. The TF coils are of the Bitter (disk) type design and therefore have negligible variation of current density in the toroidal direction. During the TF pulse, voltages are induced which cause the field and current to diffuse in the minor radial direction. This penetration, combined with the increase of resistance due to the temperature rise determines the distribution of the current. After the current distribution has been determined, the in-plane (TF-TF) and the out-of-plane (TF-PF) forces in the conductor are computed. The predicted currents and temperatures have been independently corroborated using the SPARK code which has been modified for this type of problem. 6 figs.

38177 (CONF-891007–Vol.2, pp. 1144-1147) **Coupled eddy current and thermodynamic analysis with the SPARK code.** Weissenburger, D.W. (Princeton Univ., NJ (USA)). Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

In order to accurately model the dynamic response of the Compact Ignition Tokamak (CIT) Toroidal Field (TF) coil system it became necessary to include the temperature dependence of both the electrical resistivity and the heat capacity of the conducting material. Because of the Bitter-type design of the TF system, the coil currents undergo a significant redistribution during normal operation. The eddy current code SPARK was modified to incorporate a loop voltage driver option and the primary magnetodynamic differential equations were augmented by a set of differential equations representing the adiabatic thermal response driven by the resistive power dissipation. Both a SPARK 1.2 model and a SPARK 2.0 model were analyzed in this manner. Additional modifications were also included to model the nuclear power dissipation and the current clamping of the power supply. The resulting temperature and Lorentz loads at the nodes of the model are in compatible form with the codes employed in the corresponding structural analysis. The results produced by the modified SPARK code were in good agreement with the original modeling by U. R. Christensen. 5 refs., 7 figs.

38178 (CONF-891007–Vol.2, pp. 1148-1151) **Design study of the FER (fusion experimental reactor) superconducting magnet system.** Koizumi, K. (Japan Atomic Energy Research Institute, Ibaraki (Japan)); Yoshida, K.; Hasegawa, M.; Okuno, K.; Tada, E.; Konno, M.; Tsuji, H.; Matsuda, S.; Shimamoto, S. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The preliminary design study of the superconducting magnet system for the Fusion Experimental Reactor (FER) [1] is in progress at the Japan Atomic Energy Research Institute (JAERI). This paper describes the technical specifications and the design concepts of the 12-T toroidal field (TF) coil system, the 12-T central solenoid (CS) coil system, and the 7-T equilibrium field (EF) coil system, all of which satisfy the technical requirements of the superconducting magnet system of the FER. 8 refs., 6 figs., 4 tabs.

38179 (CONF-891007–Vol.2, pp. 1152-1155) **Method for estimating failure probabilities of structural components and its application to fatigue problem of internally cooled superconductors.** Shibui, M. (Toshiba Corp., Yokohama (Japan)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A new method for fatigue-life assessment of a component containing defects is presented such that a probabilistic approach is incorporated into the CEGB two-criteria method. The present method assumes that aspect ratio of initial defect, proportional coefficient of fatigue crack growth law and threshold stress intensity range are treated as random variables. Examples are given to illustrate application of the method to the reliability analysis of conduit for an internally cooled cabled superconductor (ICCS) subjected to cyclic quench pressure. The possible failure mode and mechanical properties contributing to the fatigue life of the thin conduit are discussed using analytical and experimental results. 9 refs., 9 figs.

38180 (CONF-891007–Vol.2, pp. 1156-1159) **Pumping of gaseous helium using argon frosted liquid helium cryo-condensation pumps.** Massmann, P. (JET Joint Undertaking, Abingdon (England)); Romain, R.; Deschamps, G.H.; Falter, H.D.; Hemsworth, R.S.; Obert, W. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

It has been demonstrated in the Neutral Injection Test Bed that the JET neutral injectors are capable of producing 10 s He beams repetitively with a rate of 7 min per shot without a prohibitive pressure rise. This can be achieved without modifications to the JET liquid helium (LHe) cryo-condensation pumps. The He is pumped by cryo-sorption on Ar, which is frosted onto the LHe temperature panels before each pulse. The measured effective pumping speed is about 0.25 times the value for H_2. The measurements involved 3 cryo-pumps, 2 of the JET open structure type and one with a conventional type of liquid nitrogen (LN_2) cooled baffle. The tests show that the Ar/He coverage ratio and the thickness of the Ar layer seem to be important. The sticking coefficients for He on Ar frost derived for the 3 pumps agree with each other within the errors. 8 refs., 6 figs., 1 tab.

38181 (CONF-891007–Vol.2, pp. 1160-1163) **Recommendations for a cryogenic system for ITER (International Thermonuclear Experimental Reactor).** Slack, D.S. (Lawrence

Livermore National Lab., CA (USA)). Oak Ridge National Lab., TN (USA). [1989]. DOE Contract W-7405-ENG-48. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The International Thermonuclear Experimental Reactor (ITER) is a new tokamak design project with joint participation from Japan, the European Community, the Soviet Union, and the United States. ITER will be a large machine requiring up to 100 kW of refrigeration at 4.5 K to cool its superconducting magnets. Unlike earlier fusion experiments, the ITER cryogenic system must handle pulse loads constituting a large percentage of the total load. These come from neutron heating during a fusion burn and from ac losses during ramping of current in the PF (poloidal field) coils. This paper presents a conceptual design for a cryogenic system that meets ITER requirements. It describes a system with the following features: (a) only time-proven components are used; (b) the system obtains a high efficiency without use of cold pumps or other developmental components; (c) high reliability is achieved by paralleling compressors and expanders and by using adequate isolation valving; (d) the problem of load fluctuations is solved by a simple load leveling device; (e) the cryogenic system can be housed in a separate building located at a considerable distance from the ITER core, if desired. The paper also summarizes physical plant size, cost estimates, and means of handling vented helium during a magnet quench. 4 refs., 4 figs., 3 tabs.

38182 (CONF-891007–Vol.2, pp. 1164-1167) **Liquid nitrogen cooling for the compact ignition tokamak.** Fleming, R.B. (Princeton Univ., NJ (USA)); Martin, G.D.; Lyon, R.E. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Compact Ignition Tokamak (CIT), which is currently being designed, will have toroidal and poloidal magnetic field coils precooled by liquid nitrogen to a temperature near 80°K prior to each plasma pulse. The purpose is to gain the advantage of lower copper resistivity at reduced temperature. To maintain this temperature, the field coils, vacuum vessel, and surrounding structure will be enclosed within a cryostat. During a full-power D-T pulse, nuclear and resistive heating will impart a heat load of 11.0 GJ to the coils, which will raise the temperature of certain areas of the coils to near room temperature. The cryogenic system will supply 60,000 kg (19,500 gallons) of liquid nitrogen to remove this heat within a 60-minute cool-down period between pulses. A primary design consideration is that the nitrogen gas within the cryostat during a pulse will be activated by neutrons, producing nitrogen-13, which has a half-life of 10 minutes. This gas cannot be released into the environment without a sufficient decay period. The coolant nitrogen will therefore be contained within a closed (primary) circuit, and will be condensed in a heat exchanger. Liquid nitrogen from the supply dewars will be evaporated on the other side of the exchanger (the secondary side), and released to the atmosphere via a roof vent. Other operating modes (standby operation and initial cool-down from room temperature) are described in the paper. A safety analysis indicates that the cryogenic system will meet all applicable environmental requirements. 1 ref., 1 fig., 1 tab.

38183 (CONF-891007–Vol.2, pp. 1168-1172) **Preliminary design of the CIT cryostat.** Goins, M.L. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

For the Compact Ignition Tokamak (CIT) to achieve the performance goals set forth, the toroidal field (TF) and poloidal field (PF) coil systems must operate in a cryogenic temperature regime. The cryostat has been designed to provide and maintain this environment. The preliminary design activity is addressing the design issues and interfaces necessary to provide a cryogenic vessel that will (1) maintain a maximum temperature differential of 8°C between the outer vessel wall and the ambient test cell conditions; (2) operate in a pressure range of +5 psig to −2 psig; (3) accommodate numerous penetrations, including cooling, diagnostic, and gravity support items; and (4) maintain a maximum leak rate of gaseous nitrogen at 1 l/s at 1 atm. Conceptually, the cryostat consists of thermal insulation sandwiched between an inner primary stainless steel pressure vessel and a thin outer stainless steel wall. Design activities have concentrated on determining the size and shape of the primary vessel wall and selecting the best candidate thermal insulation materials for future irradiation testing. The following shapes of the upper and lower cryostat structure were analyzed: (1) a standard ASME torispherical domed top and bottom; (2) a nonstandard domed top and bottom; and (3) a 2° sloped conical top and bottom contour. Screening of candidate insulation materials was based on (1) lowest thermal conductivity over the range of temperatures anticipated in the CIT environment; (2) low material cost and apparent ease of assembly; and (3) survivability of material in the CIT irradiation environment. This paper presents the configuration development of the cryostat used to maintain the cryogenic temperature environment for CIT. 3 refs., 3 figs., 3 tabs.

38184 (CONF-891007–Vol.2, pp. 1173-1176) **Optimization of the poloidal transformer of ignitor.** Andritsos, F. (Commission of European Communities, Ispra (Italy)); Angelini, A. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

One of the most critical parts of the high field Tokamak IGNITOR, is the inner poloidal transformer coil. This is due not only to the high stresses developed there but also to the large quantities of energy released and the resulting high temperature. It determines the overall cooling time of the machine and thus the maximum attainable number of pulses per year. An optimization, based on a parametric study of the transformer, was performed and configuration parameters were defined. Cooling time was the quantity to be minimized, with main constraints the maximum coil temperatures and the maximum coolant outlet velocities. The cost of the cooling plant was also taken into account. The row of the conductors adjacent to the equatorial plane, which presents the highest stresses, was modeled and checked for maximum stresses. Thermal and magnetic loading, contact nonlinearity and pretensioning were considered. 8 refs., 4 figs., 12 tabs.

38185 (CONF-891007–Vol.2, pp. 1181-1184) **Oil as an alternative coolant for use in the TFTR toroidal field coils.** Gettelfinger, G. (Princeton Univ., NJ (USA)); Dahlgren, F.; Perry, E.; Walsh, J.; Walton, G.R.; Bush, H. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Tokamak Fusion Test Reactor (TFTR) has twenty toroidal field (TF) coils with a maximum current rating of 73 kA for 3.6 s when cooled with water. Operation of the TF array at this maximal current produces a 5.2 T magnetic field at a major radius of 2.48 m. Repetition rate is dependent upon the efficiency of the cooling system for the array. Each coil has eight inlets and eight outlets along the conductor's coolant channel alternating at approximately an even spacing over the 500 m length of the coil. With deionized water cooling at 10 l/s, heat is removed from each coil at a maximum rate of 1.4 MW. This produces a repetition rate of a full power pulse every 300 s as determined by the temperature reached in the reduced conductor cross-sectional area in the nose region of the TF coil. An alternative approach to water cooling would be to circulate a silicate ester (oil) instead of the usual water in the these coils. This technique would improve the electrical insulation of a leaking coil because, unlike water, the oil will not

dissolve electrolytes and, therefore, retains a high dielectric strength as it wets the insulation. The oil cooling system is composed of a pump, heat exchanger and piping and associated control and protective action circuits. Due to higher viscosity and lower heat capacity than water, oil removes 0.89 MW (max.) at 12 l/s for each coil. This decreases the repetition rate to one maximum power pulse every 900 s. 3 refs., 5 figs.

38186 (CONF-891007–Vol.2, pp. 1185-1188) **TFTR TF coil thermal analysis and test.** Dahlgren, F. (Princeton Univ., NJ (USA)); McCormack, B.; Cargulia, G.; Williams, M.; VonHalle, A. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A water cooling passage leak which developed in a TFTR toroidal field (TF) coil has precipitated interest in developing alternative cooling options for this coil system. A test on a spare coil was performed to establish a low power heating schedule and to determine the efficacy of gas cooling the TF coils. A computer analysis was also performed using the test results to benchmark the code. The investigation of gas cooling was initiated as a contingency in the event of future irreparable leaks developing in the TF coil cooling passages. It is generally acknowledged that gas leakage into the electrical insulation would have a relatively benign effect on its dielectric strength whereas recent experience on TFTR indicates a substantial degradation of dielectric strength when wetted with water (the use of high dielectric silicone oil as an alternative coolant, is discussed elsewhere in these proceedings). The purpose of the low power heating test was to establish the proper current settings and IR drop to maintain the TF coil at a prescribed temperature of 80°C, in preparation for an elevated temperature dry-out cycle on the leaking coil in TFTR. 3 figs., 9 tabs.

38187 (CONF-891007–Vol.2, pp. 1120-1124) **Two dimensional LOCA (loss-of-coolant accident) analysis for fusion reactors.** Attaya, H. (Argonne National Lab., IL (USA)); Gohar, Y. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract W-31-109-ENG-38. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Two dimensional loss-of-coolant accident (LOCA) analysis has been made for the inboard shield of a U.S. design proposed for the International Thermonuclear Experimental Reactor (ITER). The finite element heat transfer code TOPAZ2D has been used to model the inboard shield. It is assumed that the plasma continues to operate for 10 seconds after the onset of LOCA. During this time the heat source consists of the heat flux on the first wall (FW) tiles, the nuclear heating, and the radioactive decay heat. After the 10 seconds, the decay heat becomes the only heat source. The magnets are assumed intact during and after the accident and heat is radiated from the shield to the magnet's thermal shield which is at 70°K. The temperature response of the shield has been calculated up to 12.8 hours after the LOCA starts. The results show that the temperature everywhere in the shield is tolerable. The maximum temperature of the back of the shield, which is made of lead, reaches 41°C at the end of the 10 seconds plasma-on period. The maximum temperature of the first wall reaches 520°C at 7.5 hour from shutdown. After that it starts to decrease slowly. 8 refs., 5 figs., 1 tab.

38188 (CONF-891007–Vol.2, pp. 1177-1180) **Development of a forced-cooled superconducting coil for fusion applications.** Shimada, M. (Toshiba Corp., Yokohama (Japan)); Naganuma, M.; Hamajima, T.; Sawada, Y. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The test coil was wound from a NbTi cable-in-conduit type conductor with 54 strands and the total conductor length was 36 m. It was cooled with super critical helium forcedly. The critical current of the test coil was 3.5 kA at 7 tesla. The test coil was installed in a back-up coil which generated the magnetic field up to 7 tesla. This paper describes the experimental results about the propagation velocity of normal zone and the pressure rise when the forced-cooled superconducting coil quenched. The authors also analyzed the stability margin of the coil using computer simulation. 6 refs., 9 figs., 2 tabs.

38189 (CONF-891007–Vol.2, pp. 1189-1192) **Preliminary power supply design for the TF coil system of CIT.** Neumeyer, C. (Princeton Univ., NJ (USA)); Bronner, G.; Huttar, D. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Initial operation of the Compact Ignition Tokamak (CIT) is planned with a Toroidal Field (TF) of 8 Tesla and a flat top duration of 5 seconds. Ultimately, operation will be extended beyond 8 Tesla. The power supply to be used for the initial phase of operation has been modeled using the parameters of the thyristor rectifier power supplies which are now in service for the Tokamak Fusion Test Reactor (TFTR). A subset of these existing units, or perhaps new units with similar ratings, are envisioned to be connected to the existing 138kV transmission line serving PPPL so as to take advantage of this power source for CIT. For the extended operation phase the equipment used for the initial phase of TF operation will be augmented with new equipment to permit operation up to 11 Tesla. This paper describes the preliminary design for the 8 Tesla power supply and presents results from simulation studies. In addition, issues concerning transient behavior and fault modes are discussed. 4 refs., 12 figs.

38190 (CONF-891007–Vol.2, pp. 1193-1196) **The Alcator C-MOD power system.** Fairfax, S.A. (Plasma Fusion Center, Cambridge, MA (USA)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The-14 magnets or the Alcator C-MOD device require over 500 MJ to be delivered in a few seconds. Peak powers approaching 300 MW will be delivered from the upgraded 225-MVA alternator used to power the Alcator C device. Most magnets have dedicated power conversion systems in order to maximize flexibility and to allow for operation with a single-null divertor. Details of the power system design are presented. The Toroidal Field (TF) conversion system features 260 kA output coupled with an auto-tap changing design to increase power factor. The 50-kA Ohmic Heating (OH) system utilizes a single DC interrupter to switch 3 OH magnets and 3 OH converters. The vertical position control system uses a combination of fast, chopper-type supplies and conventional line-commutated converters to combine fast response with low cost. The radial position control system utilizes a reconfigured Alcator C-era OH supply in combination with surplus DC traction motors outfitted with flywheels. 12 refs., 9 figs.

38191 (CONF-891007–Vol.2, pp. 1197-1200) **PBX-M ohmic heating power supply upgrade.** Hatcher, R.E. (Princeton Univ., NJ (USA)); Bronner, G.; Lawn, F.; Lu, E.; Newman, W. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Ohmic Heating (OH) power supply performs two functions in the PBX-M experiment. The OH system provides the voltage necessary for the initial discharge breakdown, and is the primary method of plasma current drive. In 1987 the PBX device was upgraded to PBX-M. At that time, the OH power supply was reconfigured and portions of the control system were replaced. The 1987 upgrade of the OH system provides control over the amount and duration of

the voltage applied for initial discharge breakdown, more precise control of the overall current waveshape, and increases the total volt-seconds available for plasma current drive to 3 v-s. Details of the 1987 upgrade and operating experience from the previous run periods are presented along with discussions of the three leading candidate schemes for a proposed 1989 - 1990 upgrade. 6 figs.

38192 (CONF-891007–Vol.2, pp. 1206-1209) **The design of RF power supply using DC-DC converter.** Tsuneoka, M. (Japan Atomic Energy Research Institute, Ibaraki (Japan)); Takeuchi, M.; Takahashi, I. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

This paper proposes the design concept of a new RF power supply using DC-DC converters without large filter capacitors and crowbar circuits. The RF power supply is designed to get quite smoothness, fast turn off and on output characteristics. These characteristics are cleared with system simulation and a small experimental model. A 2MW (−100kV, 20A) power supply design is introduced and a view point of realization and total system efficiency are also discussed. 2 refs., 13 figs.

38193 (CONF-891007–Vol.2, pp. 1218-1221) **Analysis of the small and large versions of the IGNITEX experiment.** Montalvo, E. (Univ. of Texas, Austin (USA)); Carrera, R.; Rosenbluth, M.N. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Small and large versions of the IGNITEX experiment are defined here with emphasis on their physics basis. The models used for their definition are given. Results of volume-averaged calculations and probabilistic analysis are included. The reasons that justify considering the small and large versions of the experiment are: to define the smallest experiment that can produce fusion ignition under physics scaling pertinent to ohmically-heated, highfield tokamaks and to define the smallest experiment that can produce fusion ignition using the most pessimistic extrapolation of the scaling laws based on the auxiliary heating L-mode data base. 4 refs., 5 figs., 2 tabs.

38194 (CONF-891007–Vol.2, pp. 1222-1225) **Physics optimization of the Compact Ignition Tokamak (CIT).** Reiersen, W.T. (Princeton Univ., NJ (USA)); Schmidt, J.A.; Montgomery, D.B. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Compact Ignition Tokamak (CIT) is planned as the next major step in the U.S. fusion program. Its overall objective is to produce ignited plasma discharges. In order to realize this objective, plasma parameters must be established which are consistent with recognized theoretical and operational limits and which constitute the most cost effective path to ignition. Key parameters to be established include the plasma safety factor (q), elongation (κ), plasma current (I), toroidal field (B), and aspect ratio (A). Each of these parameters were considered in optimizing the present baseline wedged design. The CIT design team is presently developing a bucked design with enhanced plasma performance. A similar effort to optimize the bucked design is underway. 1 ref., 7 figs., 2 tabs.

38195 (CONF-891007–Vol.2, pp. 1230-1235) **Characteristics of an electron-beam rocket pellet accelerator.** Tsai, C.C. (Oak Ridge National Lab., TN (USA)); Foster, C.A.; Schechter, D.E. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

An electron-beam rocket pellet accelerator has been designed, built, assembled, and tested as a proof-of-principle (POP) apparatus. The main goal of accelerators based on this concept is to use intense electron-beam heating and ablation of a hydrogen propellant stick to accelerate deuterium and/or tritium pellets to ultrahigh speeds (10 to 20 km/s) for plasma fueling of next generation fusion devices such as the International Thermonuclear Engineering Reactor (ITER). The POP apparatus is described, and initial results of pellet acceleration experiments are presented. Conceptual ultrahigh-speed pellet accelerators are discussed. 14 refs., 7 figs.

38196 (CONF-891007–Vol.2, pp. 1236-1239) **Tritium proof-of-principle pellet injector results.** Fisher, P.W. (Oak Ridge National Lab., TN (USA)); Fehling, D.T.; Gouge, M.J.; Milora, S.L. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The tritium proof-of-principle (TPOP) experiment was built by Oak Ridge National Laboratory (ORNL) to demonstrate the feasibility of forming solid tritium pellets and accelerating them to high velocities for fueling future fusion reactors. TPOP used a pneumatic pipe-gun with a 4-mm-i.d. by 1-m-long barrel. Nearly 1,500 pellets were fired by the gun during the course of the experiment; about a third of these were tritium or mixtures of deuterium and tritium. The system also contained a cryogenic ^{3}He separator that reduced the ^{3}He level to <0.005%. Pure tritium pellets were accelerated to 1,400 m/s. Experiments evaluated the effect of cryostat temperature and fill pressure on pellet size, the production of pellets from mixtures of tritium and deuterium, and the effect of aging on pellet integrity. The tritium phase of these experiments was performed at the Tritium Systems Test Assembly (TSTA) at Los Alamos National Laboratory. About 100 kCi of tritium was processed through the apparatus without incident. 8 refs., 7 figs.

38197 (CONF-891007–Vol.2, pp. 1240-1243) **The CIT pellet injection system: Description and supporting research and development.** Gouge, M.J. (Oak Ridge National Lab., TN (USA)); Combs, S.K.; Fisher, P.W.; Milora, S.L. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Compact Ignition Tokamak (CIT) will use an advanced, high-velocity pellet injection system to achieve and maintain ignited plasmas. Two pellet injectors are provided: a moderate-velocity (1- to 1.5-km/s), single-stage pneumatic injector with high reliability and a high-velocity (4- to 5-km/s), two-stage pellet injector that uses frozen hydrogenic pellets encased in sabots. Both pellet injectors are qualified for operation with tritium feed gas. Issues such as performance, neutron activation of injector components, maintenance, design of the pellet injection vacuum line, gas loads to the reprocessing system, and equipment layout are discussed. Results and plans for supporting research and development (R and D) in the areas of tritium pellet fabrication and high-velocity, repetitive two-stage pneumatic injectors are presented. 7 refs., 4 figs., 2 tabs.

38198 (CONF-891007–Vol.2, pp. 1248-1251) **A new two-stage pellet injector for FTU.** Martinis, L. (ENEA-TIB, Rome (Italy)); Scaramuzzi, F.; Frattolillo, A.; Migliori, S.; Reggiori, A.; Riva, G.; Daminelli, G.B. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The most recent steps for developing a new generation of injectors that meet the requirements of the Frascati Tokamak Upgrade are described. Details of a new cryostat capable of building 1.6

mm diameter deuterium pellets are given. Such pellets have been successfully accelerated up to 2.8 km/s with good repeatability, using a relatively large two stage gun (0.5 m long, 3.5 cm diameter) as propeller. Simultaneously a miniature version of the propeller has been developed and tested using plastic pellets. Velocities up to 3.2 km/s were obtained. The final goal is to build a complete miniature system capable of very high pellet velocities with reduced volumes of propelling gas. 5 refs., 3 figs.

38199 (CONF-891007–Vol.2, pp. 1252-1255) **Pellet fueling of helium-3 enclosed in Li and Be shells.** Wittenberg, L.J. (Univ. of Wisconsin, Madison (USA)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The proposed design of a fuel pellet containing liquid ^{3}He enclosed in a spherical Be shell of 300 μm thickness and overcoated with D_2 solid appears to be adequate for fueling large size d/^{3}He tokamaks. Smaller pellets of this design could be used for near-term experiments. The pellet fabrication should be simple and the component are non-radioactive. 12 refs., 3 figs.

38200 (CONF-891007–Vol.2, pp. 1259-1262) **Development of upgraded pellet injector for JT-60.** Onozuka, M. (Mitsubishi Heavy Industries, Ltd., Kobe (Japan)); Shimomura, T.; Tanaka, N.; Iwamoto, S.; Hashiri, N.; Oda, Y.; Minami, M.; Hiratsuka, H.; Kawasaki, K.; Takatsu, H. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The pneumatic 4-shot pellet injector had been in use for JT-60 (JAERI Tokamak-60) contributing to plasma studies in 1988. It could propel the pellets up to 1.6 km/sec at 50 bar propellant gas. In 1989, the new gun assembly has been reinstalled in the upgraded system to provide higher performance and reliability. The supply pressure of the propellant gas is to be raised to 100 bar to obtain higher pellet velocity up to 2.3 km/sec. The device is now in use for JT-60, and is expected to contribute to further plasma studies. In this paper the outline of features and performance of the device is presented. 5 refs., 9 figs.

38201 (CONF-891007–Vol.2, pp. 1265-1270) **Physics overview of CIT.** Jardin, S.C. (Princeton Univ., NJ (USA)). Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The physics parameters and operational modes of CIT are set by a combination of detailed analysis and extrapolation from the existing tokamak data base. Some of the innovations being incorporated into the CIT design include sweeping of the separatrix across the divertor plates to spread the heat load, two-timescale radial position control utilizing both internal and external PF coils, optimized plasma shape control using a digital controller, and fusion burn control by modulating the heating source. Models of disrupting plasmas have been developed to compute structural loads. These include the effects of induced currents in the plasma halo region in which field lines intersect the vessel walls. 12 refs., 3 figs.

38202 (CONF-891007–Vol.2, pp. 1283-1286) **Basis, description, and objectives of the IGNITEX experiment.** Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The fusion ignition experiment has been recently proposed by Rosenbluth, Weldon, and Woodson as a means to produce low cost ignition soon. The basic idea is to utilize a single-turn-coil tokamak, in its ohmic regime of operation to heat a mixture of deuterium-tritium to thermonuclear conditions. The experiment has an ample ignition margin. It has the capability to produce thermally stable plasmas. Unconventional magnet and power supply technologies are used to make possible a simple and compact thermonuclear machine. The overall design simplicity of the IGNITEX experiment reduces significantly the cost of construction over the cost of more conventional approaches over the cost of more conventional approaches. The proposed IGNITEX experiment should produce and control ignited plasmas for scientific study in a simple and relatively inexpensive way. 3 refs., 3 figs., 4 tabs.

38203 (CONF-891007–Vol.2, pp. 1293-1298) **Upgrading the JET pellet injector with a two-stage light gas gun prototype and future planning.** Kupschus, P.; Sonnenberg, K.; Bailey, W.; Gadeberg, M.; Hardaker, J.; Hedley, L.; Helm, J.; Flory, D.; McCarthy, P.; Nowak, A. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

For about two years the Joint European TORUS (JET) has been using a multi-pellet injector jointly built by JET and the Oak Ridge National Laboratory (ORNL). This was and is jointly operated by a JET - US Pellet Team within the Pellet Agreement between JET and the US Department of Energy (US DOE) under the wider umbrella of the EURATOM - US DOE Agreement on collaborative Fusion Research. This injector is composed of the ORNL Launcher, employing three independently firing repetitive (up to 5 s^{-1}) pneumatic guns for pellet speeds of up to 1.5 kms^{-1}, and a JET launcher-torus interface (Pellet Interface) which provides all required services to the launcher and its immediate control system. In particular, it provides the differential pumping to match the high pressures of the gun system to the vacuum pressure and flow requirements of the plasma boundary. The Pellet Interface, in its design from its conception about four years ago, was intended to be equipped with a JET built pellet launcher system employing also high-speed guns at a later date once the ORNL Launcher will have been removed as it is not compatible with the JET requirements for the Active Phase (tritium and remote handling compatibility). As a first step - to learn about the possible plasma physics benefits as well as to gain technical experience concerning the application of advanced gun technology, a JET two-stage light gas gun prototype has been developed and is now being installed in parallel with the ORNL Launcher. This paper reports on the JET pellet injector development program, its motivation and its results to date. It describes briefly the presently operated pellet injector, continues to outline the design of the prototype in more detail and finally sketches the plans for the near future. 8 refs., 11 figs., 1 tab.

38204 (CONF-891007–Vol.2, pp. 1299-1304) **The ORNL (Oak Ridge National Laboratory) plasma fueling program.** Gouge, M.J.; Milora, S.L.; Foster, C.A.; Combs, S.K.; Fisher, P.W.; Tsai, C.C.; Argo, B.E.; Barber, G.C.; Baylor, L.R.; Fehling, D.T. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Advanced plasma fueling systems for magnetic confinement devices are under development at the Oak Ridge National Laboratory (ORNL). The general approach is that of producing and accelerating frozen hydrogen isotope pellets at speeds ranging from 1 to 2 km/s and higher. Recently, ORNL provided pneumatic-based pellet fueling systems for two of the world's largest tokamak experiments, the Tokamak Fusion Test Reactor (TFTR) and the Joint European Torus (JET). A new, versatile, centrifuge-type injector is being installed on the Tore Supra tokamak. Also, a new, simplified, eight-shot injector has been developed, and injectors based on this design are operating on the Princeton Beta Experiment (PBX) and the ORNL Advanced Toroidal Facility (ATF). In addition to these confinement-physics-related activities, ORNL is pursuing advanced technologies to achieve pellet velocities significantly in excess of 2

km/s and has carried out a tritium proof-of-principle experiment in which the fabrication and acceleration of tritium pellets were demonstrated. This paper describes these ongoing activities. 19 refs., 6 figs.

38205 (CONF-891007–Vol.2, pp. 1201-1205) **The RFX pulse transmission network.** De Lorenzi, A. (Associazione EURATOM-ENEA-CNR, Padova (Italy)); Toigo, V.; Fellin, L.; Maschio, A. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A pulse transmission network is used to transfer the energy required for the operation of RFX from the 400 kV national grid to the machine windings. It consists of an ac section, used to feed 20 ac/dc converter units and to charge several capacitor banks, and of a dc section, which connects the converter terminals and the RFX toroidal and poloidal windings. The main features of the design and of the construction are presented and discussed, together with the results of particular tests carried out on the components of the dc section. 4 refs., 8 figs., 5 tabs.

38206 (CONF-891007–Vol.2, pp. 1210-1213) **The development of long pulse high voltage power supply for MNI-$_1$U neutral beam injector.** Detai Wang (Southwestern Institute of Physics, Sichuan (China)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A high power long pulse high voltage power supply (HVPS) for MNI-$_1$U neutral beam injector (NBI) is described. This HVPS is used as a switching regulator with a duty cycle of 1/100, the specifications of circuit are as follows, output pulse voltage 50kv, pulse current 30A, pulse width 50ms, rise-time and fall-time of the voltage are less than 25 μs, stability of the pulse flat is better than 0.5%, regulation response time of the pulse voltage less than 30 μs can be attained. It is also used as a stable DC HVPS, output voltage is 1 to 100kv, current is 1 to 5A. If regulation tube is shunted with high power resistor in parallel, the current can be extended to $_{10}$A, stability of the output voltage or current is better than 0.1%. Now, the HVPS has been put into operation for MNI-$_1$U NBI and PIG ion source made in French. 3 refs., 5 figs.

38207 (CONF-891007–Vol.2, pp. 1214-1217) **Preliminary estimate of the cost breakdown for the fusion ignition experiment IGNITEX.** Carrera, R. (Univ. of Texas, Austin (USA)); Booth, W.D.; Gully, J.H.; Tucker, R.; Walls, W.A.; Weldon, W.F.; Werst, M. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A preliminary estimate of the cost breakdown for the fusion ignition experiment IGNITEX is presented here. The IGNITEX concept proposed by Rosenbluth, Weldon, and Woodson along the lines of Coppi's idea for a compact thermonuclear experiment has the potential to produce and control ignited plasmas at a relatively low cost ($130 M). The bases for the cost savings in the basic construction of the experiment are the inexpensive magnet and power supplies technologies to be used in the fabrication of the proposed 20 Tesla single-turn-coil tokamak and the simplicity of design. The cost evaluation given in this paper is consistent with the degree of the development of the IGNITEX experiment which to date has been carried out to the conceptual design level. 9 refs., 2 figs., 1 tab.

38208 (CONF-891007–Vol.2, pp. 1244-1247) **Eight-shot pneumatic pellet injector for the Advanced Toroidal Facility.** Qualls, A.L. (Univ. of Tennessee, Knoxville (USA)); Fisher, P.W.; Wilgen, J.B.; Schuresko, D.D.; Fehling, D.T.; Gouge, M.J. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

An eight-shot pneumatic pellet injector has been developed at Oak Ridge National Laboratory (ORNL). The injector is based on the pipe-gun concept, which generates hydrogen and deuterium pellets by direct condensation in the barrel. An injector based on this design is in operation on the Advanced Toroidal Facility (ATF). 2 refs., 3 figs.

38209 (CONF-891007–Vol.2, pp. 1256-1258) **Initial performance and characteristics of the PBX-M pellet injector.** Kozub, T.A. (Princeton Univ., NJ (USA)); Carson, J.M.; Fisher, P.W.; Frank, K.T.; Gibillisco, G.J.; Schuresko, D.D.; Takahashi, H.; Yager, R.W. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Princeton Beta Experiment-Modified (PBX-M) Pellet Injector Project provides for the fabrication, installation and operation of a pellet injector fueling system on the PBX-M tokamak experiment. The system consists of an eight barrel pellet gun, a pellet transport facility and a control system. The gun is an eight-shot pneumatic assembly designed and fabricated at the Oak Ridge National Laboratory (ORNL). The pellet transport and control facilities were designed, fabricated and installed by Princeton Plasma Physics Laboratory (PPPL). The integrated pellet injector system has been installed on PBX-M and is operational for use in plasma experiments. 1 ref., 7 figs.

38210 (CONF-891007–Vol.2, pp. 1310-1314) **A high-speed beam of lithium droplets for collecting diverted energy and particles in ITER (International Thermonuclear Experimental Reactor).** Werley, K.A. (Los Alamos National Lab., NM (USA)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A high-speed (160m/s) beam (0.14 x 0.86m) of liquid lithium droplets passing through the divertor region(s) below (and above) the main plasma has the potential to replace and out-perform conventional solid divertor plates in both heat and particle removal. In addition to superior heat-collection properties, the lithium beam would: (1) remove impurities; (2) have a negligible MHD lithium-circulation pressure drop; (3) exhibit low-recycle divertor operation compatible with lower hybrid current drive, H-mode plasma confinement, and no flow reversal in the edge plasma; (4) be insensitive to plasma shifts; and finally (5) protect solid structures from the plasma thermal energy for those disruptions that deposit energy preferentially into the divertor while simultaneously being rapidly re-established after a major disruption. Scoping calculations identifying the beam configuration and the droplet dynamics, including formation, MHD effects, gravitational effects, thermal response and hydrodynamics, are presented. Limitations and uncertainties are also discussed. 20 refs., 6 figs., 3 tabs.

38211 (CONF-891007–Vol.2, pp. 1315-1318) **Design of DIII-D advanced divertor.** Smith, J.P. (General Atomics, San Diego, CA (USA)); Baxi, C.B.; Reis, E.; Schaffer, M.; Thruston, G. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC03-89ER51114. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Advanced Divertor is a modification being designed for the plasma chamber of the DIII-D tokamak in order to optimize the divertor configuration and allow a broader range of experiments to be carried out. The Advanced Divertor will enable two classes of

physics experiments to be run in DIII-D: Divertor biasing and Divertor baffing. The Advanced Divertor has two principal components: (1) a toroidally symmetric baffle; and (2) a continuous ring electrode. The tokamak can be run in baffle, bias, or standard DIII-D divertor modes by accurate positioning of the outer divertor strike point through the use of the DIII-D plasma control system. The baffle will contain approximately 50,000 l/s pumping for particle removal in the outer bottom corner of the vacuum vessel. The strike point will be positioned at the entrance aperture for the baffle mode. The aperture geometry is designed to facilitate a large particle influx plus a high probability that backstreaming particles will be reionized and redirected to the aperture. Where the baffling plates meet, gas sealing is required to prevent recycling of neutrals back into the plasma. The electrode is a continuous water-cooled ring, armored with graphite. The ring is electrically isolated from the vessel wall and is biasable to 1 kV and 20 kA. The outer leg of the divertor will be positioned on the graphite covered ring during biasing experiments. The supports for the ring are radially flexible to handle the differential thermal growth between the ring and the vessel wall but stiff in the vertical direction to restrain the ring against large disruption forces. The coolant and electrical feeds are designed in a similar manner. 2 refs., 4 figs.

38212 (CONF-891007–Vol.2, pp. 1319-1322) **Results from recent hydrogen pellet acceleration studies with a 2-m railgun.** Kim, Kyekyoon (Univ. of Illinois, Urbana (USA)); Zhang, D.J.; King, T.; Haywood, R.; Manns, W.; Venneri, F. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract FG02-84ER52111. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A new 3.2-mm-diameter, two-stage, fuseless, plasma-arc driven electromagnetic railgun has been designed, constructed, and successfully operated to achieve a record velocity of 2.67 km/s[b] for a 3.2 mmD × 4 mmL solid hydrogen pellet. The first stage of this hydrogen pellet injector is a combination of a hydrogen pellet generator and a gas gun. The second stage is a 2-m-long railgun which serves as a booster accelerator. The gas gun accelerates a frozen hydrogen pellet to a medium velocity and injects it into the railgun through a perforated coupling piece, which also serves as a pressure-relieving mechanism. An electrical breakdown of the propellant gas, which has followed the pellet from the gas gun into the railgun, forms a conducting plasma-arc armature immediately behind the pellet allowing for fuseless operation of the railgun. Study of the pressure profile and the behavior of the plasma-arc armature inside the railgun bore led to elimination of spurious arcing, which prevents operation of the railgun at high voltages (and, therefore, at high currents). A timing circuit that can automatically measure the pellet input velocity and allows for accurate control of arc initiation behind the pellet helps prevent pellet disintegration and mistriggering of the arc initiation circuit. Results from the recent cryogenic operation of the two-stage pellet acceleration system are reported.

38213 (CONF-891007–Vol.2, pp. 1325-1328) **Shielding options for the ITER conceptual design.** Gohar, Y. (Argonne National Lab., IL (USA)); Attaya, H. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract W-31-109-ENG-38. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Several shield options were analyzed for the ITER conceptual design to minimize the nuclear responses in the toroidal field (TF) coils. The total nuclear heating in the physics phase and the insulator dose in the technology phase are the most critical parameters in the design process. The first shield option has type 316 stainless steel and water shielding material. Steel and water also serve as structural material and coolant, respectively. The second option is similar to the first except that borated water is used instead of ordinary water. The other two options include a small layer of lead or boron carbide (B_4C) at the back of the shield. The last three shield options were considered to reduce the nuclear heating in the toroidal field coils relative to the steel/water shield. An optimization process was performed taking into consideration the thermal-hydraulics and the engineering- requirements to define the shield configuration. A careful integration was performed to calculate the total nuclear heating in the toroidal field coils which account for the neutron wall loading distribution, the change in the shield thickness in the poloidal direction, and the space between the toroidal field coils in the divertor zone. The results show that the steel/water/Pb and the steel/borated water shield options are very close in terms of the total nuclear heating in the toroidal field coils and the dose in the insulator material. The other two options, steel/water and steel/water/B_4C deposit more nuclear heating in the toroidal field coils. 5 refs., 3 figs., 5 tabs.

38214 (CONF-891007–Vol.2, pp. 1333-1336) **Design considerations for penetrations in the TFTR radiation shield.** Ku, L.P. (Princeton Univ., NJ (USA)); Liew, S.L. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The design of radiation shield for the TFTR DT operation has to take into account the fact that many machine components and diagnostics require penetrations through the shield. The authors describe the design considerations and neutronics analyses leading to the final designs for various penetrations in the shield. Included here are the considerations for the material selection, the penetration locations, and the sizes of the back and side shields required to prevent hot spots. The consequences of leaving minor diagnostic penetrations unshielded are also addressed. 7 refs., 6 figs., 1 tab.

38215 (CONF-891007–Vol.2, pp. 1337-1339) **Multidimensional radiation analysis for the fusion ignition experiment IGNITEX.** Miller, G.A. (Univ. of Texas, Austin (USA)); Hertel, N.E.; Carrera, R.; Parish, T.A. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Multidimensional radiation analyses for IGNITEX have been performed using the Monte Carlo Neutron Photon (MCNP) code. The results of these analyses are presented in this paper including heating rates and radiation levels at various regions in the device and radiation streaming through penetrations. 4 refs., 3 figs., 6 tabs.

38216 (CONF-891007–Vol.2, pp. 1344-1347) **Silicon-carbide composite materials for the ARIES-I reactor study.** Sharafat, S. (Univ. of California, Los Angeles (USA)); Ghoniem, N.M.; Yee, L.Y. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The ARIES-I tokamak is a conceptual reactor design based on advanced technology and modest extrapolation from the present day physics database. The ARIES-I blanket utilizes SiC/SiC composite materials as structural material with helium gas as the coolant. Until recently the brittle failure behavior of monolithic ceramic materials has posed a problem for using ceramics as structural materials. Recent developments in manufacturing and processing of fiber-reinforced ceramics make SiC/SiC composites a promising candidate for future power plants. Silicon carbide composites are advantageous from a safety and waste disposal stand point because of the low activation and their very low decay afterheat respectively. The thermomechanical properties and neutron irradiation response of SiC/SiC composite materials are reviewed. Composite design equations are used to approximate a window of allowable design stresses for the first wall and blanket structures of the ARIES-I tokamak reactor. The ANSYS finite element structural analysis code is used to analyze the thermal and mechanical behavior of the first wall under normal operating conditions. It is

concluded that with minor extrapolations from today's manufacturing experience, SiC/SiC composites offer a viable structural material choice thus improving the safety and environmental aspects of future fusion power plants compared with coal or nuclear. 17 refs., 2 figs., 1 tab.

38217 (CONF-891007–Vol.2, pp. 1359-1362) **The CIT toroidal field coil and structure design and assembly approach.** Pusateri, J.A. (Princeton Univ., NJ (USA)); Citrolo, J.C. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The CIT Toroidal Field (TF) coils are capable of providing an 11 Tesla field at a plasma major radius of 2.1 meters. The plasma current will be about 12 MA. The TF coil design is based on a bucked inner leg support concept. The liquid nitrogen pre-cooled TF coils are constructed of Bitter plates and are fully encased. The bucking cylinder and the TF inner case designs are integrated into a toroidally continuous structure which also provides radial support for the Ohmic heating solenoid. The all welded support structure and coil cases are made of low-nickel austenitic stainless steel. Reinforced copper or copper alloy conductors are required for the coils to withstand the high stresses induced by the magnetic forces and thermal fields. An important consideration in the design is the effect of distortion in the structure due to final welding at assembly. The assembly method chosen, described herein, was selected from several alternates to minimize field welding and permit staged overlapping of the TF coil/structure and the vacuum vessel fabrication, delivery and assembly schedules. In addition to the description of the TF coil and structure design and assembly sequence, this paper discusses the R and D programs leading to the qualification of the selected welded assembly method. 13 figs.

38218 (CONF-891007–Vol.2, pp. 1363-1366) **Structural analysis of the toroidal field coils for the Compact Ignition Tokamak (CIT).** Brooks, A.W. (Princeton Univ., NJ (USA)); Cargulia, G.; Zatz, I. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Toroidal Field (TF) Coils for the Compact Ignition Tokamak (CIT) have undergone numerous design iterations. This paper discusses the ongoing structural analysis of the present Bucked TF Design Configuration. Included are a description of the modeling techniques and load generation which rely heavily on the TF Systems Code. Results are presented for the GlidCop (AL15) conductor baseline design. Problem areas are identified as is a discussion of tradeoffs which are underway. Present Design Allowables are presented and discussed. 4 refs., 11 figs., 1 tab.

38219 (CONF-891007–Vol.2, pp. 1367-1370) **Superstructure for a super tokamak: Alcator C-MOD.** Ballinger, R. (Massachusetts Institute of Technology, Cambridge (USA)); Becker, H.; Hwang, I.; Titus, P.; Fisher, K.; Werber, K. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

ALCATOR C-MOD is a compact high performance tokamak presently being constructed by the Massachusetts Institute of Technology under contract to the US Department of Energy. The purpose of the program is to study the production, confinement, heating, and control of strongly shaped, fully diverted, high density plasmas. The high toroidal magnetic field produces extremely large forces on the magnet conductors. Those loads are reacted by an external superstructure. The machine will be operated in a pulsed mode, with a design life of 50,000 cycles. That combination places exceptional requirements on the design, materials processing, and fabrication of the superstructure components. The superstructure consists of a large forged AISI 316LN pressure vessel that is assembled with alloy 718 fasteners. The chemistries and thermomechanical processing techniques were selected to provide the necessary mechanical properties at both room temperature and at the 77K operating temperature. This presentation addresses the superstructure design, stress analysis, materials processing, static and fatigue properties, components fabrication, and inspection. 13 refs., 2 tabs.

38220 (CONF-891007–Vol.2, pp. 1375-1378) **Microwave Tokamak Experiment (MTX) ohmic heating system.** Jackson, M.C. (Lawrence Livermore National Lab., CA (USA)). Oak Ridge National Lab., TN (USA). [1989]. DOE Contract W-7405-ENG-48. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The ohmic heating system for the Microwave Tokamak Experiment (MTX) at Lawrence Livermore National Laboratory (LLNL) provides both the voltage for the initial breakdown phase and the energy to drive the plasma current to a value of 400 kA or greater. Providing this voltage and flux swing requires a one turn loop voltage of about 25 volts (11 kV across the coil) and a magnetic flux swing of 2 volt-seconds. This voltage and flux swing are accomplished by charging the ohmic heating coils to 20 kA, at which point the current is commutated off into a resistor generating the 11 kV across the coil. When the current passes through zero, another power supply drives the current in the opposite polarity to 20 kA, thus completing the full 2 volt-second flux swing. This paper describes the design features and performance of the ohmic heating circuit, with emphasis on the commutation circuit. In addition, the paper describes the use of the ohmic heating system for discharge cleaning and the change over procedure. 3 refs., 4 figs., 1 tab.

38221 (CONF-891007–Vol.2, pp. 1384-1387) **The RFX energy transfer units.** Benfatto, I. (Associazione EURATOM-ENEA-CNR, Padova (Italy)); Maschio, A.; Feilcke, F.; Roesler, D.; Weyer, H. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

RFX will make use of four energy transfer units to give rise to the plasma current. The design parameters of these units are 50kA, 35kV, with a duty cycle of 5 s every 10 min, and an I^2t of 5×10^9 A^2s. The switching elements are based on vacuum interrupters with a self produced axial magnetic field, with $\pm$ 1 ms of jitter in the mechanical operation of the actuator and an electrical life at the maximum current of at least 1,500 interruptions. The counterpulse network is designed to extinguish the current in the interrupters with a mean value of 600 A/μs for the di/dt, which reduces to less than 100 A/μs near the current zero. Finally, the control and monitoring system is described, together with the interface to the main control system of the experiment. 6 refs., 11 figs., 6 tabs.

38222 (CONF-891007–Vol.2, pp. 1393-1396) **Activation analysis for the LIBRA light ion beam fusion conceptual design.** Sawan, M.E. (Univ. of Wisconsin, Madison (USA)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Activation calculations have been performed for the LIBRA reactor. Replacing HT-9 by low activation modified HT-9 increases the activity by a factor of 2.5 at shutdown while the long term activity drops by a factor of 25. The reflector is classified as Class C low level waste when modified HT-9 is used. Using HT-9 will require deep geological burial for the LIBRA radwaste. The activity produced in the $Li_{17}Pb_{83}$ coolant has been determined. ^{210}Po is the major contributor to the coolant BHP between a week and a year

after shutdown. During this period the ^{210}Po BHP values change from 7×10^5 to 1.2×10^5 km^3 of air. 6 refs., 7 figs., 3 tabs.

38223 (CONF-891007–Vol.2, pp. 1397-1401) **Laboratory microfusion facility - Neutronics and radiological safety analysis.** Tobin, M.T. (Lawrence Livermore National Lab., CA (USA)); Singh, M.S.; Meier, W.R. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract W-7405-ENG-48. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The primary goal of the Laboratory Microfusion Facility (LMF) is to conduct some 1,400 target experiments over a 5-year period to demonstrate high gain in the laboratory. Projected yields for these experiments range from <10 MJ to 1,000 MJ. High gain experiments are expected to be conducted once per week. After high gain (> 10x input energy) has been achieved, target yields above 100 MJ will be used to conduct weapons physics and weapons effects experiments. In addition, experiments will be conducted to assess the viability of inertial fusion for electric power production, space propulsion and space power. This will extend the facility lifetime to as much as 30 years. All aspects of the facility will meet the US Department of Energy (DOE) radiological siting requirements, the International Commission on Radiological protection (ICRP) (and DOE) public dose limits, the DOE occupational dose limits, and the more stringent LLNL as low as reasonably achievable (ALARA) guidelines. It will also meet the EPA proposed emission standards for radionuclides. The authors have set two design goals that minimize the affect of radiation hazards on the operation of the facility. The first is that LMF workers will have access to the diagnostic platforms outside the target chamber within 24 hours after a high-yield shot. This is necessary for retrieving data and preparing for the next experiment. Although it is plausible that routine interior chamber operations may be done remotely, workers may occasionally require access to the inside of the chamber for special tasks. Therefore, the second design goal is that workers can safely enter the chamber for a short time 7 days after a high-yield experiment. 13 refs., 3 figs., 2 tabs.

38224 (CONF-891007–Vol.2, pp. 1348-1351) **Study of an advanced D-T tokamak fusion reactor with compact fusion advanced rankine (CFAR) cycle.** Yoshikawa, K. (Kyoto Univ., (Japan)); Ohnishi, M.; Yamamoto, Y.; Shimohiro, D.; Inui, Y.; Ishikawa, M.; Umoto, J.; Kometani, H.; Fukuyama, A.; Mitarai, O. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Recent progress of the CFAR (Compact Fusion Advanced Rankine) cycle concept for a D-T tokamak reactor is presented with emphasis on how an enthalpy extraction can be achieved by a nonequilibrium disk-type MHD generator. For the gas stagnation temperatures of 3,000 K, enthalpy extraction in excess of 50% is found to be achievable, leading to a 40% overall plant efficiency with application of recuperative heat cycle and recently advanced thermoelectric converters. About 6 ton/sec mercury flow is required to remove fusion energy while achieving the 3,000 K gas stagnation temperature prior to the MHD generator. Studies of plasma parameters in the steady-state operation regime subject to plasma physics constraints, the minimum power in the start up phase required for ignition, effects of MHD magnet to the plasma confining magnetic fields, neutron and microwave superheat, and mercury corrosion test of ceramic rods for 2,000 hours are also described. 14 refs., 6 figs., 1 tab.

38225 (CONF-891007–Vol.2, pp. 1305-1309) **Operation and reliability of a pneumatic hydrogen pellet injection system on the Joint European Torus.** Combs, S.K. (Oak Ridge National Lab., TN (USA)); Jernigan, T.C.; Baylor, L.R.; Milora, S.L.; Foust, C.R.; Kupschus, P.; Gadeberg, M.; Bailey, W. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A pneumatic-based, hydrogen isotope pellet injector that was developed at the Oak Ridge National Laboratory for the plasma fueling application on the Joint European Torus (JET) was described at the last Symposium on Fusion Engineering (1987). The injector was installed on JET during 1987 and has since been used in plasma fueling experiments. The injector consists of three independent machine-gun-like mechanisms (nominal pellet sizes of 2.7, 4.0, and 6.0 mm in diameter), and it features repetitive operation (1-5 Hz) for quasisteady-state conditions (> 10 s). An extensive set of injector diagnostics permits evaluation of parameters for each pellet shot, including speed, mass, and integrity. Pellet speeds can be varied but typically range from 1.0 to 1.5 km/s. Over 5,000 pellets have been fired with the equipment at JET, including about 2,000 pellets shot for plasma fueling experiments. In recent experiments, the system performance has been outstanding, including excellent reproducibility in pellet speed and mass and a reliability of >98% in delivery of pellets to the plasma. 7 refs., 5 figs.

38226 (CONF-891007–Vol.2, pp. 1329-1332) **Shielding design options for the TF magnets of ITER (International Thermonuclear Experimental Reactor).** El-Guebaly, L.A. (Univ. of Wisconsin, Madison (USA)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Optimization studies were performed to design an efficient shield to protect the toroidal field (TF) magnets of the International Thermonuclear Experimental Reactor (ITER). Several options for the shield design were examined and many shielding materials have been evaluated. The pure SS/H_2O shield does not satisfy the magnet radiation limits. When boron carbide, lead, or boron steel is incorporated in the shield, all design limits are met. The highest damage occurs at the midplane of the inner legs and at the top/bottom parts of the magnets due to the limited space for the shield. The safety factors associated with the different magnet responses were quantified. These factors account for the increase in damage due to the presence of the assembly gaps between the shield modules and the uncertainties in data, codes, and modeling. 6 refs., 1 fig., 4 tabs.

38227 (CONF-891007–Vol.2, pp. 1340-1343) **Neutron shielding system for the DIII-D research facility.** Anderson, P.M. (General Atomics, San Diego, CA (USA)); Phelps, R.D.; Venkatesh, M.C. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC03-89ER51114. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The research program for the DIII-D tokamak has been expanded to include experiments using deuterium plasmas and deuterium neutral beams. In the absence, of additional shielding, the increased radiation levels associated with these experiments are calculated to exceed the DOE guidelines of 20 mr/yr above background at the site boundary. To minimize overall exposure, a shielding system has been installed at the DIII-D facility to completely surround the machine pit area inside the building. 5 refs., 5 figs.

38228 (CONF-891007–Vol.2, pp. 1355-1358) **Stress analysis of JT-60U tokamak.** Horie, T. (Japan Atomic Energy Research Institute, Ibaraki (Japan)); Ando, T.; Horlike, H.; Kushima, T.; Matsukawa, M.; Neyatani, Y.; Ninomiya, H.; Yamamoto, M. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Stress analyses of the JT-60U vacuum vessel and the PF coil support structures are described. A new method is proposed to treat the non-linear friction force acting on PFC support structures from the PF coils. The result of the stress analysis indicates the validity of the present method. Various candidates for the vacuum vessel structure and the support method are compared to determine the basic concept of the machine. The multi-arc cross section vacuum vessel with midplane supports proved to have sufficient strength through both the static and the dynamic stress analyses, so that this concept is adopted as the JT-60U vacuum vessel. The dynamic coupled effect between the PFC support structures and the vessel is estimated to assess the strength of the clamps which fix the structures from the base. 2 refs., 7 figs., 3 tabs.

38229 (CONF-891007–Vol.2, pp. 1371-1374) **DIII-D F-coil chopper selection, control and fault recognition system.** Burley, B.L. (General Atomics, San Diego, CA (USA)); Smith, T.L. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC03-89ER51114. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The DIII-D fusion experiment uses 18 field-shaping coils (F-coils) to control position and shape of a plasma discharge. The DIII-D F-coils are powered and controlled by configuring single or parallel operation of up to 50 modular, 3 kAmp, 3 kHz, 2 quadrant switching power supplies (choppers) and 9 dc power supplies. The dc power supplies provide the raw power for the choppers while the choppers control the current in the F-coils. Through the use of a special high current patch panel, any similar (600 V or 1,200 V) chopper can be connected to any of the 18 F-coils. This allows efficient reassignment of power supplies for a variety of fusion experiments. The control system for such a flexible system must also allow the quick reassignment of chopper controls and incorporate a fault detection system to protect power supplies and the fusion experiment. The Chopper Selection, Control, and Fault Recognition system meets this need through the use of state-of-the-art computer bus switching networks and programmable array logic (PAL) circuitry. The chopper selection and control system uses computer bus switching networks to select individual chopper controls for a specific F-coil. Thumbwheel switches identified for specific DIII-D F-coils are used to program the selection of each chopper power supply. A single coil and the controls for that coil can be connected to 1 or all of the chopper power supplies. In practice no more than 6 chopper power supplies are assigned to any single F-coil. 3 refs., 1 fig.

38230 (CONF-891007–Vol.2, pp. 1379-1383) **Electromagnetic compatibility of the machine measuring equipment in RFX experiment.** Campostrini, P.P. (Associazione EURATOM-ENEA-CNR, Padova (Italy)); Toigo, V.; Stella, A. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

In the RFX experiment many kinds of transducers are used in order to measure a great deal of parameters related to the machine monitoring, control and protection. Such devices have to be located and are called to operate in a rather noisy environment. A first source of possible electromagnetic interference is represented by the air-core ohmic heating magnet system, which produces a magnetic field relatively strong within a wide area around the machine. Further sources of noise have been identified in the Power Supply system. In the paper, after a description of the principal measurement requirements and of the expected noise sources, the possible physical mechanisms by which noise and signals can be coupled are shown. A detailed explanation of the precautions taken in order to keep the interference within acceptable limits is then given. In particular the design and the shielding criteria of the Local Control Room, where the majority of the control equipment of the Power Supply system are to be located, is presented. The behavior of a type of current transformer, which allows by means of an auxiliary circuit the extension of the frequency response down to DC is also presented, with regard to its electromagnetic compatibility. 10 refs., 8 figs., 2 tabs.

38231 (CONF-891007–Vol.2, pp. 1388-1392) **Commissioning tests and simulation result comparison in RFX AC/DC converters.** Gaio, E. (Associazione EURATOM-ENEA-CNR, Padova (Italy)); Piovan, R. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The commissioning phase of the RFX ac/dc converter system is now completed and the units are ready for the integration with the other plant equipments. Standard and special tests were carried out to verify that the converter operation meets all the design requirements both in normal conditions and in the case of fault. In the paper the tests are described and their results are given and discussed. The test results also confirm the suitability of computer codes and component electrical models, which were developed during the design phase in order to simulate the machine circuits and to derive the main design choices for the converter units. Examples of comparison between computer simulations and experimental tests are given in a few significant cases. 6 refs., 14 figs., 1 tab.

38232 (CONF-891007–Vol.2, pp. 1407-1411) **Ball lightning as a route to fusion energy.** Roth, J.R. (Univ. of Tennessee, Knoxville (USA)). Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The reality of ball lightning is attested to by observations reported in surveys of large populations, which are the subject of several books. These observations indicate that its characteristics may be relevant to fusion energy applications. Ball lightning can have a diameter up to several meters, a lifetime of over 100 seconds, an energy content in excess of 10 megajoules, and an energy density and a kinetic pressure greater than that of a reacting DT plasma. This paper reviews some of the properties of ball lightning which commend it to the attention of the fusion community, and it discusses some potential advantages and applications of ball lightning fusion reactors. 11 refs., 6 figs., 1 tab.

38233 (CONF-891007–Vol.2, pp. 1412-1415) **Dose rate calculations for a light ion beam fusion Laboratory Microfusion Facility.** Khater, H.Y. (Univ. of Wisconsin, Madison (USA)); Sawan, M.E. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A preliminary study of the target chamber design for a light ion beam driven Laboratory Microfusion Facility (LMF) has been performed. The LMF will explode fusion targets with yields between 10 and 1,000 MJ over a period of 30 years inside a 1.5 m radius chamber. Activation analysis has been performed for the target chamber and the resulting dose rates calculated. The calculations were performed for three different chamber wall materials: the ferritic steel 2 1/4 Cr-1 Mo, the Al-6061-T6 alloy and a low activation modified Al-5083 alloy. The target chamber is submerged in a borated water pool for neutron shielding. The detailed pulsing schedule has been modeled in the activation calculations. The aluminum chambers result in contact dose rate levels much lower than those from the steel chamber in the period between one week and five years after shutdown. However, except for the Al-5083 chamber, one still has to wait several years for the contact dose rate to drop to tolerable levels. Limiting access for maintenance to distances greater than 1 m from the chamber allows maintenance to start in a few days after shutdown if the borated water remains in place. If the borated water is drained out after shutdown, maintenance for the aluminum chambers can start after two weeks. 8 refs., 7 figs., 2 tabs.

38234 (CONF-891007–Vol.2, pp. 1416-1419) **Sirius-T, a symmetrically illuminated ICF tritium production facility.** Sviatoslavsky, I.N. (Univ. of Wisconsin, Madison (USA)); Sawan, M.E.; Moses, G.A.; Kulcinski, G.L.; Engelstad, R.L.; Larsen, E.; Lovell, E.; MacFarlane, J.; Peterson, R.R.; Wittenberg, L.J. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A scoping study of a symmetrically illuminated ICF tritium production facility utilizing a KrF laser is presented. A single shell ICF target is illuminated by 92 beams symmetrically distributed around a spherical cavity filled with xenon gas at 1.0 torr. The driver energy and target gain are taken to be 2 MJ and 50 for the optimistic case and 1 MJ and 100 for the conservative case. Based on a graphite dry wall evaporation rate of 0.1 cm/y for a 100 MJ yield, the authors estimate a cavity radius of 3.5 m for a rep-rate of 10 Hz and 3.0 m for 5 Hz. A spherical structural frame has been scoped out capable of supporting 92 blanket modules, each with a beam port in the center. They have selected liquid lithium in vanadium structure as the primary breeding concept utilizing beryllium as a neutron multiplier. A tritium breeding ratio of 1.83 can be achieved in the 3 m radius cavity which at 10 Hz and an availability of 75% provides an annual tritium surplus of 32.6 kg. Assuming 100% debt financing over a 30 year reactor lifetime, the production cost of T_2 for the 2 MJ driver case is $7,325/g for a 5% interest rate and $12,370/g for a 10% interest rate. 8 refs., 3 figs., 4 tabs.

38235 (CONF-891007–Vol.2, pp. 1420-1423) **Texas experimental tokamak electron cyclotron resonant heating system.** Pavlovsky, D.A. (Univ. of Texas, Austin (USA)); Jagger, J.W.; Terry, D.R.; Foster, D.L. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract FG05-88ER53267. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Electron cyclotron resonant heating of the plasma in the Texas Experimental Tokamak (TEXT) has been achieved with a single gyrotron system, and is presently being expanded to a three gyrotron system. Each gyrotron can provide up to 200 kilowatts of rf power into the plasma. Future expansion includes a fourth gyrotron capable of delivering an additional 500 kilowatts of rf power into the plasma. A description of the overall system architecture is given in this paper. Also discussed is the overall grounding scheme and the high-voltage power distribution system. The utilization of fiber-optic links in the control system to reduce noise problems associated with high-voltage systems, provide high-voltage isolation, and eliminate ground loops is also discussed. 3 refs., 5 figs.

38236 (CONF-891007–Vol.2, pp. 1424-1427) **First JT-60 system high power 110 to 130 MHz test results with an X2242 tetrode.** Moriyama, S.; Ogawa, Y.; Fujii, T.; Anno, K.; Shinozaki, S.; Terakado, M.; Kimura, H.; Saigusa, M.; Kobayashi, N.; Ohta, M. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Tests of the X2242 were run in the JT-60 ICRF system. The tests evaluated this newly developed tetrode's performance under conditions relevant to the planned CIT and JT-60U ICRF systems. Also, these tests studied the behavior of a large high power tube at frequencies above 100MHz. The X2242 is similar in all dimensions to the 8973 (the original JT-60 ICRF output tube). The X2242 has increased screen and grid dissipation and cathode emission. (Specifications of the tube and tube related test results are included in [1].) The JT-60 ICRF amplifier was designed to deliver 0.75MW at 110 to 131MHz. Only these modifications were required for the higher power tube: (a) new filament, bias, and screen grid power supplies; (b) a second output port for higher RF voltage at the port. The modified amplifier worked very well. In addition to the modifications, a new high power load, a high power stub tuner and a high power phase shifter were provided to allow testing with VSWR from 1 to 3 at phase angles from 0 to 360 degree. Also complete instrumentation including an acoustic monitor to sense boiling at the tube anode to permit prompt diagnosis was provided. High power test results were: 1.6MW for 0.5 seconds at 131 MHZ, 1.0MW for 10 seconds at 131MHz, 1.5MW for 6 seconds at 110MHz. (These parameters were limited by screen grid heating concerns.) These values are close to the goals of the CIT and JT60U ICRF system specification. After the high power test operational range tests were performed under variable VSWR conditions. Performance was studied under load VSWR of 1.5 and 2 over a 0 to 360 degree phase range. With VSWR of 1.5, plate dissipation was 1.4 times higher than that of matched load. All these tests provided valuable data and insight about the high frequency performance of large tubes. 5 refs., 6 figs., 1 tab.

38237 (CONF-891007–Vol.2, pp. 1432-1437) **Thermal and stress analysis of the Faraday shield for the ORNL/TFTR RF antenna.** Hammonds, C.J. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)); Nelson, B.E.; Walls, J.C.; Hoffman, D.J.; Baity, F.W. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The rf antenna designed and built by Oak Ridge National Laboratory (ORNL) for the Tokamak Fusion Test Reactor (TFTR) is an ion cyclotron resonance heating antenna operating in the 40- to 80-MHz frequency range with a power output of 4 MW for a 2-s pulse. The antenna was delivered to Princeton in November 1987. A review of the antenna design began in early 1988 to ensure compatibility with D-T operation of TFTR. Owing to the serious consequences of a water leak during D-T operation and to other concerns, it was concluded that the Faraday shield of the antenna should be rebuilt. In addition, because of increased heat loads and more stringent acceptance criteria, a new thermal and stress analysis of the shield was authorized. 1 ref., 8 figs., 5 tabs.

38238 (CONF-891007–Vol.2, pp. 1444-1447) **Design of the ITER (International Thermonuclear Experimental Reactor) neutral beam system beamline, United States concept.** Purgalis, P.; Anderson, O.A.; Cooper, W.S.; DeVries, G.E.; Lietzke, A.F.; Kunkel, W.B.; Kwan, J.W.; Matuk, C.A.; Nakai, T.; Stearns, J.W. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Design of a neutral beamline for ITER (International Thermonuclear Experimental Reactor) is described. The design incorporates a barium surface conversion D^- source feeding a linear array of accelerator channels. The system uses a dc accelerator with electrostatic quadrupoles for strong focusing. A high voltage power supply that is integrated with the accelerator is presented as an attractive option. A gas neutralizer is used and residual ions exiting the neutralizer are deflected to watercooled dumps. Cryopanels are located at the accelerator exit to pump excess gas from the source and the neutralizer, and in the ion dump cavity to pump reneutralized ions and neutralizer gas. All the above components are packaged in compact identical, independent modules that can be removed for remote maintenance. The neutral beam system delivers 75 MW of D^0 into three ports with a total of nine modules arranged in stacks of three modules per port. To increase reliability each module is designed to deliver up to 10 MW at 1.3 MeV; this allows eight modules operating at partial capacity to deliver the required power in the event one module is removed from service. Radiation protection is provided by shielding and by locating critical components in the source and accelerator 35 m from the port into the torus. Neutron shielding in the drift duct provides the added feature of limiting conductance and thus reducing gas flow to and

from the torus. Alternative component choices are also discussed for the evolving design. 8 refs., 4 figs., 1 tab.

38239 (CONF-891007–Vol.2, pp. 1448-1454) **A neutral particle beam system for ITER with rf acceleration.** Stirling, W.L. (Oak Ridge National Lab., TN (USA)); Becraft, W.R.; Wheatlon, J.H.; Haselton, H.H. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The main, bulk current-driving system candidates appear to include only two: (1) fast wave with the ion cyclotron range of frequencies (ICRF) and (2) negative-ion-based neutral beams. The authors have further investigated the possible approaches of achieving the greater than 1 MeV, high-power neutral beams and have concluded that a systems using a radiofrequency quadrupole accelerator has the most promise of reaching the energy and power needs of a reactor for a reasonable development. The system concept presented here represents some modest modifications to the designs of other neutral particle beam applications - in particular, applications found in linear accelerators with output energies of tens of megaelectron volts. These systems comprise the same components as those required for the ITER system. The major components to be considered are the (1) ion source, (2) LEBT (low-energy beam transport), (3) injector bending magnets, (4) accelerator, (5) neutralizer, and (6) beam dump. 16 refs., 9 figs., 1 tab.

38240 (CONF-891007–Vol.2, pp. 1455-1458) **Design and construction of the neutral beam injector for compact helical system (CHS).** Kaneko, O. (National Institute for Fusion Science, Nagoya (Japan)); Ando, A.; Oka, Y.; Takeiri, Y.; Kohmoto, T.; Karita, A.; Kuroda, T.; Kai, T.; Masuda, K.; Watanabe, Y. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A 40keV 1.2MW Neutral Beam Injector for the Compact Helical System (CHS) device has been constructed for the purpose of producing high pressure plasma. The beam line consists of one ion source, and is characterized by changeable injection angle for optimizing beam deposition, and for investigating confinement of high energy ions. A new technology for manufacturing cooling channels of extracting grids (both copper and molybdenum) is developed. The physical requirement on the neutral beam and the design features of the injector are presented. 4 refs., 10 figs.

38241 (CONF-891007–Vol.2, pp. 1459-1462) **TFTR neutral beam bellows redesign and calorimeter upgrade.** McDade, J. (Princeton Univ., NJ (USA)); Dudek, L.; Kaminsky, E.; Lontai, L.; Williams, M. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

TFTR has experienced calorimeter bellows failures at lower duty cycles than anticipated. The paper will consist of a description of the history of the problems, the analysis and testing that went into the solution of the problem within present design constraints. Guidelines for future bellows designs of this type and application (long stroke and vertical operation) will be presented. Improvements incorporated in the other components associated with the calorimeter assembly will also be described. 2 refs., 5 figs., 1 tab.

38242 (CONF-891007–Vol.2, pp. 1463-1466) **Control system for the Texas Experimental Tokamak ECRH system.** Terry, D.R. (Univ. of Texas, Austin (USA)); Mixon, W.W.; Pavlovsky, D.A.; Jagger, J.W. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The electron-cyclotron-resonance heating (ECRH) system for the Texas Experimental Tokamak (TEXT) is currently being expanded to include three 200-kilowatt gyrotrons. A fourth, half-megawatt gyrotron is to be added in the future. A personal computer is used to control the gyrotrons and their power supplies. A second computer provides additional display-screen space. Aside from a single emergency-off pushbutton, the operator controls the entire system with a mouse. Hardware logic is the interface to the computer reacts to events too fast for the computer to handle, such as tube arcs, and backs up the software in areas of equipment and personnel safety, such as the door-interlock system. Timers on boards plugged into the computer are used to generate signals that must be fast or precisely timed. Signals from the tokamak's control system provide synchronization of the ECRH pulses with the tokamak cycle. All analog and digital signals between the control system and the rest of the equipment are light links, and optical coupling is used extensively within the control system. The computer monitors and displays approximately two hundred digital and twenty-five analog inputs and generates about fifty digital and two analog outputs. A third computer provides data-logging capability, and a fourth computer provides the operator with on-line access to all system documentation. 2 refs., 3 figs.

38243 (CONF-891007–Vol.2, pp. 1467-1470) **PC-Link historical data base system MODCOMP/IBM at link for neutral particle beam operation.** Thurgood, P. (General Atomics, San Diego, CA (USA)). Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC03-89ER51114. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

PC-Link is a combination of hardware and software that connects an IBM PC/AT to a MODCOMP minicomputer. It is designed as an aid to the Neutral Beam operations coordinator during injection into the DIII-D tokamak project. An IBM PC/AT is linked to 4 MODCOMP realtime acquisition systems, each of which controls 2 neutral particle beam sources. At various points in the shot sequence, data is sent to the IBM PC/AT. This data can then be integrated with the data from the other sources into tables or graphics displays for use by the Beam Coordinator. In this way, the coordinator gets realtime feedback on the relative settings and performance of the sources and can observe trends within a particular source at one location. The PC-Link is used for observing relative timing information and for post shot historical archiving. The concept of the PC-Link was originally proposed several years ago. In April 1988, in-house implementation of the link software was begun. The PC-Link receives approximately 2 Kbytes of data per source per shot. This data is converted from MODCOMP format to IBM PC format and archived to disk. The last 280 shots per source are stored to disk to observe trends. The data can be displayed in a number of formats depending upon the situation. For example, prior to a shot, the beam MODCOMPs are sent timing information from the DIII-D tokamak control system. This data is echoed on the PC in a graphical representation displaying all 8 sources. At the end of the shot, the actual running times are displayed along with the requested settings. Any subset of the Historical data may be displayed either graphically or in tables for realtime comparisons between sources. 4 figs.

38244 (CONF-891007–Vol.2, pp. 1471-1473) **The design of the CPRF (Confinement Physics Research Facility) control system.** Wilkins, R.W. (Los Alamos National Lab., NM (USA)); Klingner, P.L. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract W-7405-ENG-36. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Confinement Physics Research Facility (CPRF), currently under construction at Los Alamos, is a facility for research into the plasma confinement properties of various magnetic field configurations. The first device to be tested in the CPRF will be ZTH, a reversed field pinch. The CPRF/ZTH control system has been designed as a distributed system with four major semi-independent subsystems. Each subsystem will be capable of stand alone operation for purposes of commissioning and maintenance. The subsystem controller hardware has been selected; it will consist of commercially available programmable logic controllers (PLCs) linked by a fast fiber optic network. The man-machine interface, which is under procurement as of June, 1989, will have multiple graphic workstations interfaced to the PLC fiber optic network. The central control console will initially have three stations. Permanent local stations will be located at two of the subsystems with a transportable station serving the remaining subsystems. Standard process control software will be used, but the selection criteria emphasize the open architecture of the system so that user programs can be easily integrated. 2 figs.

38245 (CONF-891007–Vol.2, pp. 1474-1478) **The control system for the multiple-pellet injector on the Joint European Torus.** Baylor, L.R. (Oak Ridge National Lab., TN (USA)); Jernigan, T.C.; Stewart, K.A. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

A stand-alone control and data acquisition system for the Oak Ridge National Laboratory (ORNL) multiple pellet injector installed on the Joint European Torus (JET) has been designed and installed with the injector. This system, which is based on a MicroVAX II computer and a programmable logic controller (PLC), is an upgrade of previous systems designed for ORNL pellet injectors installed on other fusion experiments. The primary control system upgrades are in the user interface, in the automation of sequential injector operation, and in the analysis of the transient data acquired for each pellet fired. The system is integrated into the JET CODAS environment through CAMAC communications modules with customized communications software. Routine operation of the injector is automated and requires no operator intervention. Details of the hardware and software design and the operation of the system are presented in this paper. 4 refs., 3 figs.

38246 (CONF-891007–Vol.2, pp. 1479-1481) **TFTR neutral beam automated thermocouple monitor.** Lawson, J.E. (Princeton Univ., NJ (USA)); Satkofsky, J.; McCormack, B.; Oldaker, M.; O'Connor, T.; Segers, R. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Each of the four neutral beam lines on TFTR contains 368 type E thermocouples used to monitor the temperature of the various water cooled surfaces that can receive beam power. These surfaces include the calorimeters, ion dumps, magnets and the scrapers. Currently these temperatures must be checked manually by the operator any time the accel grid voltage changes by more than 10 kV. A thermocouple scanning system has been designed which will automate the checking of these thermocouples during beam pulsing and provide monitoring for excessively cold water temperatures during periods when the cryogenic system is operating unattended. This system automatically activates the appropriate alarms, indicates out of limit thermocouples and, in the case of excessive temperatures, inhibits subsequent beam pulsing. This system consists of five VME based microcomputer systems, one attached to each beam line for data acquisition and processing and a central unit for monitoring, display interlocks, and alarms. 5 figs.

38247 (CONF-891007–Vol.2, pp. 1482-1486) **Safety analysis of the Compact Ignition Tokamak (CIT) release of activated solid material.** Lyon, R.E. (Idaho National Engineering Lab., Idaho Falls (USA)); Holland, D.F. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073 ;AC07-76ID01570. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Recent safety studies for the Compact Ignition Tokamak (CIT) have addressed the potential risk associated with the release of activated solid materials from sources such as the vacuum vessel and the TF coils, including insulation, as a result of off-normal events associated with the machine. A number of initiating events have been identified that could lead to mobilization of the activated material and the maximum quantities that could be mobilized have been estimated. These events include: a gas break into the torus releasing tokamak dust, plasma disruptions vaporizing first wall material, graphite combustion volatilizing activated structural material, and magnet arcs volatilizing magnet or torus material. Several operating scenarios, both bounding and realistic, have been investigated to determine a spectrum of isotope concentrations which might be present in the materials. Source terms for the various release scenarios are established using this information. The various release modes are identified along with factors which could reduce the amounts of activated material actually released. From this information, the doses resulting from a spectrum of releases are presented and discussed. A number of factors, identified in the paper, lead to the conclusion that accidental release of activated solids does not present a significant public risk from the operation of CIT. 11 refs., 2 tabs.

38248 (CONF-891007–Vol.2, pp. 1487-1491) **Safety implications of a graphite oxidation accident in the Compact Ignition Tokamak device.** Merrill, B.J. (Idaho National Engineering Lab., Idaho Falls (USA)); O'Brien, M.H. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC07-76ID01570. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

This paper addresses the possible safety consequences of an air ingress accident for the Compact Ignition Tokamak (CIT) device. An experimental program was undertaken to determine oxidation rates of four nuclear grade graphites in air at temperatures ranging from 800 to 1,800 C and flow velocities from 3 to 7 m/s. On the basis of these test results, an analytic model was developed to assess the extent of first wall/divertor protective tile oxidation and the amount of energy released from this oxidation. For CIT, a significant restriction to vacuum vessel air inflow will be provided by the air seals and walls of the surrounding test cells. Under these conditions, the graphite oxidation reaction inside the vacuum vessel will become oxygen starved within minutes of the onset of this event. Since significant oxidation rates were not achieved, the heat release did not elevate structural temperatures to levels of concern with regard to activated material release. 7 refs., 9 figs.

38249 (CONF-891007–Vol.2, pp. 1495-1497) **Radiation safety management during a TFTR shutdown.** Walton, G.R. (Princeton Univ., NJ (USA)); Gilbert, J.D. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Maintenance and repair activities on the Tokamak Fusion Test Reactor (TFTR) during shutdowns have become significantly complicated due to the vacuum vessel having become radioactive by neutron activation during high power pulse (HPP) operation. In-vessel work has been affected to a greater extent by the presence in the vessel of removable tritium surface contamination exceeding 17 Bq/100cm^2 (1,000 dpm/100 cm^2). A radiation exposure management program has been established at TFTR for distributing exposures to a larger group thus minimizing individual doses. The program also incorporates methods of personnel and hardware

contamination control. Facilities have been set up for the decontamination of hardware and anti-contamination clothing. The operation of these facilities leads to considerable cost savings for materials that otherwise would have been disposed of at approved sites. The proper methods of reworking activated and/or contaminated materials is important in contamination control. Dedicated shop and assembly areas are used to complete such operations as machining and rebuilding. All operations described above are performed under the guidance of the Health Physics Branch. The relatively low levels of activation and contamination encountered so far have been a good rehearsal for D-T operation. 8 refs., 3 figs.

38250 (CONF-891007–Vol.2, pp. 1498-1501) **The use of Computer Aided Management of Emergency Operations (CAMEO) at the Tokamak Fusion Test Reactor (TFTR).** Del Gandio, P. (Princeton Univ., NJ (USA)); Stencel, J.R. Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Computer Aided Management of Emergency Operations (CAMEO) is a software package for personal computers designed to enhance emergency preparedness and response involving chemical fires or spills. It was specifically designed by National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA). The Princeton Plasma Physics Laboratory (PPPL) has combined fire fighting and hazmat response together in CAMEO and adapted it for use at the Tokamak Fusion Test Reactor (TFTR). 4 refs., 6 figs.

38251 (CONF-891007–Vol.2, pp. 1402-1406) **Neutronics issues for starlight: An inertial confinement fusion reactor concept.** Tobin, M.T. (Lawrence Livermore National Lab., CA (USA)). Oak Ridge National Lab., TN (USA). [1989]. DOE Contract W-7405-ENG-48. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Features of the STARLIGHT reactor concept may represent significant improvements in ICF reactor design. The reactor will allow an arbitrary illumination geometry for the reactor driver, the reactor will have few moving parts, and the use of a shield integrated with the ICF target assembly will extend the bare first wall lifetime otherwise limited by the wall ablation caused by x rays and target debris. Here the authors discuss an evolving design by reporting results of 1- and 2-D calculations involving tritium breeding, neutron damage, and the beam port neutron leakage. They conclude that an ICF reactor using a solid breeder is feasible. A low-temperature option is the use of a steel first wall and Li_2O as the breeding material. This first wall has an expected lifetime of more than six years. Further, up to 10 cm thickness can be tolerated before the tritium breeding ratio falls below unity. They are unaware of a suitable high temperature first wall material for a high-temperature option. This option would use a ceramic first wall and breed tritium in $LiAlO_2$, allowing all the reactor components to operate at high temperatures that allow efficient use of He as a coolant. Of the ceramics examined, SiC appears to be the best choice for considering both tritium breeding and wall lifetime. However, the production will limit that lifetime to five months, clearly not an economical lifetime. Further, Li_2O is necessary rather than $LiAlO_2$ (at 7 cm wall thickness) to achieve a favorable tritium breeding ratio with SiC. Here, the benefits of using ceramics are lost as Li_2O has a much lower melting point than $LiAlO_2$. Increased leakage of neutrons through beam ports is a concern when very thick breeding zones are used. 12 refs., 3 figs., 1 tab.

38252 (CONF-891007–Vol.2, pp. 1428-1431) **First tests of the Varian EIMAC X2242 at 110 and 130 MHz in the JT-60 ICRH system.** Loring, M. (Varian EIMAC San Carlos, CA (USA)); Remsen, D.; Fujii, T.; Nagashima, T.; Ohta, M.; Moriyama, S.; Shinozaki, S.; Terakado, M.; Anno, K.; Ogawa, Y. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

The Varian EIMAC X2242 utilizes pyrolytic graphite screen and control grids and a high density mesh cathode in a new multi-megawatt tetrode. It is capable of delivering 3MW of output power. Tests were performed in a modified, well instrumented, JT-60 ICRH Amplifier. Tests were run at 110 and 131 MHz at pulse widths to 10 seconds. Output power to 1.5 MW at 110 MHz and 1.6 MW at 131 MHz was observed. The amplifier was stable with significant reverse screen grid current. The reverse screen grid current was found to be caused by RF heating of the screen grid. During these tests, output power was limited because of screen grid temperature concerns. Screen grid heating (i.e. reverse current) was found to depend on $f^{5/2}$, P_0, and plate load resistance. Tests were also performed at 110 MHz with VSWR's of 1.5:1 and 2:1 (at 1.0 and 0.75 MW respectively) at phase angles from 0 to 315 degrees. Internal examination of the tube after its return showed it to be undamaged. The lack of damage illustrates the high temperature capabilities of pyrolytic graphite. Means to increase tube power output at these frequencies are being developed. 5 refs., 6 figs.

38253 (CONF-891007–Vol.2, pp. 1438-1443) **Beamline duct gas release conditioning and the upgraded duct wall protection system of the JET neutral injection.** Bickley, A.J. (JET Joint Undertaking, Abingdon (England)); Jones, T.T.C.; Papastergiou, S.; Challis, C.D.; Davies, J.F.; de Esch, H.P.L.; Stork, D.; Altmann, H. Oak Ridge National Lab., TN (USA). [1989]. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

During injection of neutral beams into the JET Tokamak, there have been three occasions when damage to the water cooled duct liner has occurred due to re-ionization within the duct region. As a result, improved duct protection and direct fast pressure gauges have been installed. The pressure measurements are analysed in terms of a gas re-emission coefficient and results for various surface conditions have been obtained. The mechanical design of a new improved duct protection system is also presented. 6 refs., 10 figs., 1 tab.

38254 (CONF-891007–Vol.2, pp. 1492-1494) **Emergency operations procedures development and training.** Leonard, M. (Princeton Univ., NJ (USA)). Oak Ridge National Lab., TN (USA). [1989]. DOE Contract AC02-76CH03073. From 13. IEEE symposium on fusion engineering; Knoxville, TN (USA); 2-6 Oct 1989. In *IEEE thirteenth symposium on fusion engineering. Proceedings: Volume 2.* Order Number DE90009370. Available from IEEE Service Center, Single Publications Sales Dept., 445 Hoes Lane, Piscataway, NJ 08855-1331.

Proper response to emergency situations saves lives, reduces equipment damage and prevents an embarrassing aftermath. Due to the complexity of the emergency response, all large industrial facilities need to be prepared for emergencies. The emergency response at magnetic fusion facilities is even more complex due to their special characteristics of high voltages, extreme temperatures and radiological hazards. The complexity of emergency response requires proper coordination and communications between emergency operations personnel. Therefore, it is imperative that Emergency Operations Procedures (EOPs) be written and personnel be trained in these procedures.

38255 (CONF-8810231–11) **Pellets in large tokamaks TFTR and JET.** Schmidt, G.L. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Hammet, G.; Hulse, R.; Owens, D.K.; Baylor, L.R. JET/USDOE Pellet Collaboration. Oak Ridge National Lab., TN (USA). [1988]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From IAEA technical committee meeting on pellet injection and toroidal confinement; Gut Ising (Germany, F.R.); 24-26 Oct 1988. Order Number DE90012791. Available from NTIS, PC A02/MF A01; OSTI; INIS.

In TFTR and JET experiments, pellet fueling has been extended to larger, higher temperature devices. We will review selected current results in the light of earlier experiments. Penetration depths are generally in agreement with modelling when ablation by thermal electrons dominates, but local deposition may differ from predictions based solely on the prepellet Te profile. Deposition at the plasma edge can be enhanced. Deposition near the plasma center may also be altered, particularly in JET. Fueling efficiency is high, but at present strongly peaked density profiles are obtained only with pellet penetration approaching or beyond the plasma center. Density achieved with pellets in ohmic plasmas is greater than that attainable with deuterium gas puffing in both these large devices as in previous experiments. Locked modes limit this density in JET but not yet in TFTR. Strong electron temperature perturbations can be tolerated in these large devices as on smaller machines allowing modification of the current profile leading to a change in the time evolution of the central q value and suppression of existing sawtooth relaxations or delay of their onset. With heating, Te > 5 keV is rapidly achieved. Axial voltages may strongly decrease. Under these conditions central particle loss rates can be enhanced. Decay rates in JET at 5 – 8 keV are approximately 0.75 s. Energy confinement is observed to improve in TFTR ohmic discharges as was seen in earlier experiments.

38256 (DOE/DP/10779–T1) **Measurements of laser wavelength scaling ion acoustic decay instability and associated effects in laser-plasma interaction experiments: Final report.** Mizuno, K. (California Univ., Davis, CA (USA)); De Groot, J.S.; Seka, W. California Univ., Davis, CA (USA). Jun 1989. 21p. Sponsored by U.S. DOE Defense Programs. DOE Contract AS03-88DP10779. Order Number DE90011434. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have made extensive studies of Ion Acoustic Decay Instabilities (IADI) in laser-pellet interactions under the program of the National Laser User Facility at LLE. We have observed well-defined IADI. In this paper it is shown that IADI is potentially important in laser fusion applications. The threshold decreased as the laser spot size increased. The measured threshold is an order of magnitude lower that previously reported values in small spot experiments. The threshold values for IR and short wavelength Green lasers are quite low, and reached homogeneous-plasma collisional values in a planar plasma produced by a large spot size laser irradiations. The results are explained in agreement with LASNEX calculations with a flux limit of f = 0.1. These low threshold values indicate that IADI is potentially important in a large scale plasma, and even in short-wavelength laser-pellet interactions which are applicable to laser fusion research. It is shown that IADI is a useful tool for plasma diagnostic near the critical surface. We have shown that ion charge state Z can be measured using IADI signals. These measurements are possible without resorting to any complicated atomic physics model. At high intensity regimes, IADI spectrum is quite different from the medium intensity regime. A broad turbulent-like spectrum is observed.

38257 (EGG-FSP–8255) **Combustion testing and thermal modeling of proposed CIT [Compact Ignition Tokamak] graphite tile materials.** O'Brien, M.H.; Merrill, B.J.; Ugaki, S.N. EG and G Idaho, Inc., Idaho Falls, ID (USA). Sep 1988. 30p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE90013090. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Oxidation rates of four nuclear grade graphite products — Union Carbide TS1792m Poco AFX-5Q, FMI 4D Weave C-C Composite, and Pfizer pyrolytic — were measured from 800 to 1800°C for two air flow rates. With the resulting data, power balance modeling was used to predict the rates of graphite tile loss for the proposed Compact Ignition Tokamak (CIT) reactor under different accident scenarios. Experimental results show that above ~1000°C the reaction rate is controlled by the oxygen supply. Below this temperature the reaction rate is controlled by chemical kinetics and oxygen supply. Calculated activation energies for these two kinetic regions were 18.8 and 47.5 kJ/mol, respectively. An accident scenario was proposed in which both a top and a bottom viewing port seal were broken while tile surface temperatures were still at 1100°C. Predictions based upon simple energy balance modeling indicate that a significant portion of the protective tiles on the CIT vacuum vessel could be oxidized, possibly releasing a significant amount of hazardous tritium oxide. Further analytical studies are proposed. 22 refs., 12 figs., 1 tab.

38258 (EGG-M–89521) **Parametric design studies of toroidal magnetic energy storage units.** Herring, J.S. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC07-76ID01570. (CONF-900801–15: 25. intersociety energy conversion engineering conference, Reno, NV (USA), 12-17 Aug 1990). Order Number DE90013086. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Superconducting magnetic energy storage (SMES) units have a number of advantages as storage devices. Electrical current is the input, output and stored medium, allowing for completely solid-state energy conversion. The magnets themselves have no moving parts. The round-trip efficiency is higher than those for batteries, compressed air or pumped hydro. Output power can be very high, allowing complete discharge of the unit within a few seconds. Finally, the unit can be designed for a very large number of cycles, limited basically by fatigue in the structural components. A small systems code has been written to produce and evaluate self-consistent designs for toroidal superconducting energy storage units. The units can use either low temperature or high temperature superconductors. The coils have 'D' shape where the conductor and its stabilizer/structure is loaded only in tension and the centering forces are borne by a bucking cylinder. The coils are convectively cooled from a cryogenic reservoir in the bore of the coils. The coils are suspended in a cylindrical metal shell which protects the magnet during rail, automotive or shipboard use. It is important to note that the storage unit does not rely on its surroundings for structural support, other than normal gravity and inertial loads. This paper presents designs for toroidal energy storage units produced by the systems code. A wide range of several parameters have been considered, resulting in units storing from 1 MJ to 72 GJ. Maximum fields range from 5 t to 20 T. The masses and volumes of the coils, bucking cylinder, coolant, insulation and outer shell are calculated. For unattended use, the allowable operating time using only the boiloff of the cryogenic fluid for refrigeration is calculated. For larger units, the coils have been divided into modules suitable for normal truck or rail transport. 8 refs., 5 tabs.

38259 (GA-A–19294) **Research operations on reversed field pinch: Final report, February 12, 1986–January 31, 1988.** Tamano, T. General Atomics, San Diego, CA (USA). Apr 1988. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-86ER53228. Order Number DE90012985. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report discusses: characteristic of RFP plasmas with resistive shell system; vertical field control and sustainment of RFP discharges in the resistive shell system; MHD stability of RFP configurations with surrounding vacuum region; studies of RFP relaxation mechanisms and plasma confinement; and ultra low q discharges.

38260 (LA-UR–90-850) **The effects of exchange gas temperature and pressure on the beta-layering process in solid deuterium-tritium fusion fuel.** Hoffer, J.K. (Los Alamos National Lab., NM (USA)); Foreman, L.R.; Simpson, J.D.; Pattinson, T.R. Los Alamos National Lab., NM (USA). [1990]. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-900806–4: 19. international conference on low temperature physics, Brighton (UK), 16-22 Aug 1990). Order Number DE90009015. Available from NTIS, PC A02/MF A01 - OSTI.

It has recently been shown that when solid tritium is confined in an isothermal enclosure, self-heating due to beta decay drives a net sublimation of material from thick, warmer layers to thin, cooler ones, ultimately resulting in layer thickness uniformity. We have observed this process of "beta-layering" in a 50–50 D-T mixture in both cylindrical and spherical enclosures at temperatures from 19.6 K, down to 11.6 K. The measured time constants are found to depend on the ^{3}He content as suggested by recent theoretical predictions. When using an enclosure having low thermal conductivity, the ultimate layer uniformity is found to be a strong function of the exchange gas pressure. This is due to the presence of thermal

convection in the exchange gas and consequent temperature anisotropy at the solid layer surface. 6 refs., 2 figs., 1 tab.

38261 (SAND–89-2845C) **A laser-produced lithium ion source for pulsed-power inertial confinement fusion.** Bieg, K.W.; Tisone, G.C.; Lockner, T.R.; Bailey, J.E.; Cuneo, M.E.; Clark, B.F.; Potter, J.E.; Schanwald, L.P. Sandia National Labs., Albuquerque, NM (USA). [1989]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9007111–4: 8. international conference on high-power particle beams, Novosibirsk (USSR), 2-5 Jul 1990). Order Number DE90013401. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We are investigating direct laser-produced plasmas as an ion source for the PBFA II pulsed power accelerator. Laser-generated plasmas have several potential advantages for this application, including the ability to generate a pre-formed anode plasma, simplicity, and flexibility. Previous experiments have shown that a high-density lithium plasma can be produced by direct laser irradiation of a solid lithium surface with a pulsed dye laser tuned to the Li 1s-2p resonance line at 670.8 nm (Laser Ionization Based on Resonant Saturation–LIBORS). We are also investigating a two-step approach, which uses a short-pulse Nd:YAG laser to efficiently vaporize the lithium-bearing source material, followed by LIBORS ionization of the evolving vapor to produce plasmas of mid-10^{16}/cm^3 densities. 8 refs., 6 figs.

38262 (SAND–89-2866C) **Design of a light-ion-beam driver for the Laboratory Microfusion Facility.** Prestwich, K.R.; Ramirez, J.J.; Stinnett, R.W.; Johnson, D.L.; Olson, C.L.; Clauser, M.J.; Mehlhorn, T.A.; Desjarlais, M.P.; Allshouse, G.O.; Corley, J.P. Sandia National Labs., Albuquerque, NM (USA). [1990]. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9007111–1: 8. international conference on high-power particle beams, Novosibirsk (USSR), 2-5 Jul 1990). Order Number DE90013071. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The US Department of Energy has initiated planning for a Laboratory Microfusion Facility (LMF) as part of the national Inertial Confinement Fusion (ICF) program. This next major ICF facility is expected to produce a 1000-megajoule thermonuclear yield with greater than 10-megajoules of input energy to the target. As part of this initiative, we have defined a light-ion-beam LMF concept and are pursuing research in critical design issues. Details of this light-ion-beam LMF driver concept are presented together with initial results from an LMF research program aimed at a technology validation experiment on Hermes III. 16 refs., 4 figs.

38263 (SAND–89-2927C) **Performance of magnetically injected plasma opening switches for the Particle Beam Fusion Accelerator 2 (PBFA 2).** Rochau, G.E.; McDaniel, D.H.; Mendel, C.W. Jr.; Sweeney, M.A.; Moore, W.B.S.; Mowrer, G.R.; Simpson, W.W.; Zagar, D.M. Sandia National Labs., Albuquerque, NM (USA). [1990]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. (CONF-9007111–2: 8. international conference on high-power particle beams, Novosibirsk (USSR), 2-5 Jul 1990). Order Number DE90012920. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Plasma opening switch experiments using a magnetically injected plasma have been in progress since October 1988. Plasma densities of 1 x 10^{12} to 2 x 10^{13} e/cm^3 have been injected from the anode side into the 8 cm gap of the 20 ohm magnetically insulated transmission line of PBFA II using a slowly rising $B_{r,z}$ magnetic field. This field confines the azimuthally-uniform plasma to produce switches up to 30 cm in length. Four MIP geometries have been investigated to find a higher electrical impedance when the switch opens. These studies have shown that a separation of 10 to 20 cm from the load is important to keep the POS from affecting the load performance. With such a separation, 20 to 30 TW of power at 7 to 11 MV has been delivered to electron and ion diode loads. Data on switch performance with various loads and factors that improve performance are discussed. 4 refs., 6 figs.

38264 (UCRL–50021-87, pp. 1.1-1.7) **Laser program overview.** Coleman, L.W. Lawrence Livermore National Lab., CA (USA). Jul 1989. In *Laser Program annual report 1987.* Order Number DE90008198. Available from NTIS, PC A05/MF A01.

In 1987, the Laser Program at Lawrence Livermore National Laboratory made outstanding progress in its research on inertial confinement and high-average-power lasers. The continuing objective of the Inertial Confinement Fusion (ICF) element of the laser program are to understand and develop the science and technology of ICF so that its full spectrum of capabilities and benefits can be realized. Progress was made in the following areas: (1) target design; (2) target materials development; (3) laboratory x-ray lasers; (4) laser science and technology; (4) high-average-power lasers; and (5) ICF applications studies. Also briefly discussed are program resources and program facilities. 2 figs.

38265 (UCRL–50021-87, pp. 2.1-2.97) **Target design.** Weber, S.V. Lawrence Livermore National Lab., CA (USA). Jul 1989. In *Laser Program annual report 1987.* Order Number DE90008198. Available from NTIS, PC A05/MF A01.

The year of 1987 was a period of outstanding progress and success in design and modeling for both the Nova and Halite programs. The models developed over the last several years have proved capable of accurately calculating almost all the main features of Nova experiments including laser deposition, hohlraum temperatures, temperature gradients, and shock pressures. These experiments cumulate in the ability to design capsules with radial convergence ratios in excess of 30 that achieved near one-dimensional yields. The bulk of the 1987 ICF laser target work on Nova consisted of extremely successful indirect-drive implosions. In addition, a few direct-drive targets, such as gold disks, were shot. Exciting advances were made in soft x-ray lasing using the nickel-like 4d to 4p scheme. This work along with other development in soft x-ray laser design is reported. An important goal of the ICF program is to model the physics of laser-target coupling more accurately. To this end the Plasma Physics Group carries out theoretical studies and simulations on the interaction process, develops models, and works closely with experimental groups in designing and interpreting laser plasma experiments. 149 refs., 86 figs.

38266 (UCRL–50021-87, pp. 3.1-3.257) **Nova experiments.** Campbell, E.M. Lawrence Livermore National Lab., CA (USA). Jul 1989. In *Laser Program annual report 1987.* Order Number DE90008198. Available from NTIS, PC A05/MF A01.

Nova's activities are directed toward the experimental demonstration of the feasibility of inertial confinement fusion. The principle experimental tool is the Nova laser facility which has been operational since 1985. During the past year, critical advances were made in laser science and in developing new technologies to improve Nova's routine performance to its original design level. The following pertinent topics are covered in this paper: (1) Nova operation and laser science; (2) amplifier development for the Nova laser; (3) Nova computer systems; (4) laser experiments and advanced diagnostics; and (5) Nova target fabrication. 401 refs., 243 figs., 27 tabs.

38267 (UCRL–50021-87, pp. 4.1-4.34) **Target materials development.** Haendler, B.L. Lawrence Livermore National Lab., CA (USA). Jul 1989. In *Laser Program annual report 1987.* Order Number DE90008198. Available from NTIS, PC A05/MF A01.

Foams are being developed for the direct-drive inertial confinement (ICF) target. The target design calls for a spherical shell of foam that can be wetted with liquid deuterium-tritium (DT). The liquid DT is both fuel and ablator: the foam holds the DT in a spherical shell configuration that is compressed to high density and ignited by laser energy. The three foam materials discussed here are (1) polystrene foams, (2) resourcinol-formaldehyde foams, and (3) cellulose acetate foams. Finally a discussion is given on target specifications and foam properties related to target production. 19 refs., 27 figs., 1 tab.

38268 (UCRL–50021-87, pp. 5.1-5.106) **Laser research and development.** Powell, H.T. Lawrence Livermore National Lab., CA (USA). Jul 1989. In *Laser Program annual report 1987.* Order Number DE90008198. Available from NTIS, PC A05/MF A01.

The principle objective of the Laser Research and Development Program is to identify and develop laser technology necessary to meet near-term and long-term Laser Program goals. Two laser systems will be needed to meet these goals. The first system will be used to further develop physics of laser-driven implosions, with the

objective of producing the high density, high-temperature plasma necessary for fusion. The second laser system would be used to drive an ICF reactor to generator commercial electric power. The technical requirements for this system are beyond the state of the art for solid state lasers or any other drivers. The areas of laser research covered are: (1) solid state laser components; (2) optical materials and coatings; (3) advanced nonlinear materials; (4) advanced crystalline materials; (5) advanced large-dimension crystal growth; (6) basic materials research; and (7) theoretical atomic and molecular physics. 196 refs., 81 figs., 30 tabs.

38269 (UCRL–50021-87, pp. 6.1-6.93) **High-average-power solid state lasers.** Summers, M.A. Lawrence Livermore National Lab., CA (USA). Jul 1989. In *Laser Program annual report 1987.* Order Number DE90008198. Available from NTIS, PC A05/MF A01.

In 1987, a broad-based, aggressive R&D program aimed at developing the technologies necessary to make possible the use of solid state lasers that are capable of delivering medium- to high-average power in new and demanding applications. Efforts were focused along the following major lines: development of laser and nonlinear optical materials, and of coatings for parasitic suppression and evanescent wave control; development of computational design tools; verification of computational models on thoroughly instrumented test beds; and applications of selected aspects of this technology to specific missions. In the laser materials areas, efforts were directed towards producing strong, low-loss laser glasses and large, high quality garnet crystals. The crystal program consisted of computational and experimental efforts aimed at understanding the physics, thermodynamics, and chemistry of large garnet crystal growth. The laser experimental efforts were directed at understanding thermally induced wave front aberrations in zig-zag slabs, understanding fluid mechanics, heat transfer, and optical interactions in gas-cooled slabs, and conducting critical test-bed experiments with various electro-optic switch geometries. 113 refs., 99 figs., 18 tabs.

38270 (UCRL–50021-87, pp. 7.1-7.38) **ICF applications studies.** Tobin, M.T. Lawrence Livermore National Lab., CA (USA). Jul 1989. In *Laser Program annual report 1987.* Order Number DE90008198. Available from NTIS, PC A05/MF A01.

The focus of the ICF Application Group at LLNL shifted dramatically this year form far future applications to the near term design of the follow-on facility to Nova - the Laboratory Microfusion Facility (LMF). The authors discuss the design considerations that must be resolved to successfully operate an LMF. These issues include developing vaporization and condensation models, studying beam quality degradation after transport through protective but turbulent gases, and determining damage thresholds for fused silica exposed to x rays. Because cost is a major concern in the design of this facility, they also evaluated the possibility of using the existing Nova target chamber as the LMF's EA to lower cost. General studies conducted in 1987 concerned two familiar ICF themes: safety and economics. 46 refs., 19 figs., 12 tabs.

38271 (UCRL–101179) **Design of thick aperture for fine-resolution neutron penumbral imaging.** Ress, D. Lawrence Livermore National Lab., CA (USA). 19 Oct 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8910419–1: Institute for Electrical and Electronics Engineers (IEEE) conference, Stanford, CA (USA), 23 Oct 1989). Order Number DE90012078. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Compact sources of 14-MeV neutrons have been imaged with a penumbral-coded aperture at a two-point resolution of 80μm. We desire to improve the penumbral-aperture microscope to obtain resolutions as fine as 10μm. In penumbral-coded-aperture imaging, the resolution is ultimately limited by the sharpness of the aperture point-spread function. I present a design for a thick penumbral aperture that provides the desired sharpness over a field of view of 150μm. The point-spread function of these apertures is sufficiently isoplanatic and distortion-free to allow linear reconstruction of complex source distributions. The designs is generally appropriate for similar imaging techniques, such as fine-resolution neutron or gamma-ray pinhole imaging. 5 refs., 5 figs.

38272 (UCRL–101641) **Laser conditioning of optical thin films.** Wolfe, C.R.; Kozlowski, M.R.; Campbell, J.H.; Rainer, F.; Morgan, A.J.; Gonzales, R.P. Lawrence Livermore National Lab., CA (USA). 8 May 1989. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8911192–3: 1989 Boulder damage symposium, Boulder, CO (USA), 1-3 Nov 1989). Order Number DE90013483. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Results are presented that show the damage thresholds of e-beam deposited multi-layer HfO_2/SiO_2 thin films can be permanently increased by a factor of 2 to 3 by illumination with subthreshold fluences of laser light. This subthreshold illumination procedure is referred to as "laser conditioning." The films used in this study were prepared by three different physical-vapor-deposition techniques: ion-beam sputtering, plasma plating and e-beam evaporation. Only the e-beam deposited films showed consistent and significant improvement with laser conditioning. Of the material pairs examined (HfO_2/SiO_2, ZrO_2/SiO_2 and TiO_2/SiO_2), HfO_2/SiO_2 gave the greatest and most consistent damage improvement with conditioning. The number of layers and the reflective or transmissive characteristics of the HfO_2/SiO_2 films were found to have little impact on laser conditioning of the film. The results show that the damage thresholds of a wide range of e-beam deposited coatings (e.g. HR's, polarizers, etc.) can be improved by laser conditioning. Several possible conditioning mechanisms are examined. 40 refs., 10 figs.

38273 (UCRL–101643) **Large area laser conditioning of dielectric thin film mirrors.** Kozlowski, M.R.; Wolfe, C.R.; Staggs, M.C.; Campbell, J.H. Lawrence Livermore National Lab., CA (USA). 30 May 1990. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8911192–4: 1989 Boulder damage symposium, Boulder, CO (USA), 1-3 Nov 1989). Order Number DE90013485. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The laser conditioning of dielectric thin film HR coatings has been studied as a practical method for the improvement of the damage thresholds of large area (1.1 m dia.) high power 1064 nm laser mirrors on the LLNL 120kJ, 100TW Nova laser system. Both HfO_2/SiO_2 and /ZrO_2/SiO_2HR coatings were conditioned by rastering with a small (~0.2 mm) diameter beam from a pulsed (18 Hz, 8 ns) Nd-YAG laser (1064 nm). The samples were rastered at various fluences below the unconditioned damage threshold and subsequently damage tested. Large area conditioning studies were also performed using a large aperture beam of the Nova laser. The laser conditioning effect was found to be permanent. Improvements in damage threshold due to conditioning were as high as a factor of 2.7 and were dependent on the conditioning parameters. A model for the conditioning effect is proposed based on emptying of electronic defect levels within. 36 refs., 9 figs.

38274 (UCRL-CR–103896) **A plan for the study of the costs and environmental impact of fusion compared with alternative energy sources: Final report.** Meier, W.R.; Monsler, M.J. Schafer (W.J.) Associates, Inc., Chelmsford, MA (USA). 28 Mar 1990. 30p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90013068. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Based on our work during this contract and our discussions with LLNL personnel at the presentation made to LLNL on Wednesday, February 14, we have defined the following set of tasks for a study on the total cost of fusion compared to alternative energy sources. The proposed study is not intended to be exhaustive or comprehensive. It will, however, help LLNL to develop a greater understanding, to quantify some comparisons between fusion power and alternative energy sources, and to communicate the benefits of fusion to Congress and other decision makers. We recommend that the study focus on energy use in the US, but conclusions relative to global factors should be included to the extent possible.

38275 (UCRL-ID–104103) **Physics study of the application of an IFEL [Induction Free-Electron Laser] to CIT [Compact Ignition Tokamak]: Interim report.** Hooper, E.B. (ed.). Lawrence Livermore National Lab., CA (USA). 22 May 1990. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48.

Order Number DE90011276. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The ECH system requirements on CIT might be met by microwaves generated by an induction free-electron laser (IFEL). Design studies have assumed that the system is windowless, thus eliminating one of the most highly stressed components of the ECH system. The trade-off for this advantage is that the IFEL is exposed to tritium diffusing from CIT. As reported in the attached appendix, we have investigated the use of cryopumping to control the tritium diffusion to the IFEL. With one to three pumping stations (depending on size) we can reduce the level of tritium in the IFEL to a level that may not pose a breathing hazard after one year of operation. In addition, adding pumping may allow hands-on maintenance after one year. Preliminary indications are that likely accident scenarios will occur slowly enough to permit valves to be closed before the IFEL is significantly contaminated.

38276 (UCRL-JC-103314-Rev.1) **MTX [Microwave Tokamak Experiment] diagnostics and timing system for FEL [free electron laser] heating experiments: Revision 1.** Casper, T.; Allen, S.; Foote, J.; Fenstermacher, M.; Hooper, E.; Lasnier, C.; Meyer, W.; Moller, J.; Nilson, D.; Rice, B. Lawrence Livermore National Lab., CA (USA). [1990]. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-900557-11: 8. topical conference on high-temperature plasma diagnostics, Hyannis, MA (USA), 6-10 May 1990). Order Number DE90013067. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In the MTX program, we are concentrating on experiments using intense, FEL-generated microwave pulses. In initial FEL experiments, several diagnostic instruments were operated during injection of microwave pulses with peak powers to 0.2 GW at durations of 10 nsec. Fixed and spatially scanning microwave detectors and receivers and a 48-element calorimeter on the inside wall of MTX diagnosed the GW-level FEL microwave pulses to study linear wave absorption and to determine efficiencies of transmission through the quasi-optical transport system. In addition, several radially resolved measurements of plasma density, temperature, and emission were made during FEL injection and used in the analysis of microwave absorption data. A timing system, slaved to the FEL pulse arrival time is capable of accuracy to a few nanoseconds in order to allow measurement of heating effects on the time scale of a single FEL pulse. We will discuss operation of these diagnostics and our plans for future measurements of single pulse and high average power heating experiments. 6 refs., 5 figs.

38277 **Modelling of the vapor shield mechanism during high heat flux ablation of surfaces.** Gilligan, J. (North Carolina State Univ., Raleigh, NC (USA)); Hahn, D.; Mohanti, R. pp. 40 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). Contract DAAL-86-K-0029. (CONF-8905184-: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

A formal solution for the radiative transfer equation has been derived in order to compare with the results using the diffusion approximation. One can obtain an analytic solution of the radiative transfer equation for the steady state case where the temperature and density distributions and also the radiation field are independent of time. In order to compare the equivalent quantities, the code magfire is run first until quasi-stead state is reached, and then by using the profiles of density and temperature calculated, the analytic solution for the stead state multigroup radiative transfer equation is obtained.

38278 **Experimental and simulation studies of collisionless plasma flow.** Morgan, M.A. (Northeastern Univ., Boston, MA (USA)); Chan, C.; Cooke, D.; Tautz, M. pp. 96-97 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184-: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

In modelling the steady-state flow of a collisionless plasma or an ion beam from a source region into a source free area, by means of the Poisson-Vlasov set of equations, a non-physical build-up of positive charge occurs a short distance away from the discharge point that soon acts to impede further flow out of the source. Such an occurrence is seldom observed in the laboratory and the question of what is the appropriate electron model to mitigate this effect, has been of concern for some time now.

38279 **Initial tests of a 10 MW, 35 GHz phase-locked gyrotron oscillator driven by a pulseline accelerator.** Gold, S.H. (Naval Research Lab., Washington, DC (USA). Plasma Physics Div.); Fliflet, A.W.; Black, W.M.; Kirkpatrick, D.A.; Manheimer, W.M. pp. 52 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184-: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The experiment has been fabricated and cold tested. In initial experimental operation, free-running oscillation at 35 GHz has been observed at about 5 MW output power. The TE_{112} mode of the bunching cavities has been observed to oscillate early in the pulse, but generally not during the voltage flattop, so that is should not interfere with the phase-locking process. Phase-locking experiments are under way.

38280 **Numerical simulation of collective ion acceleration in the laser controlled collective accelerator.** Striffler, C.D. (Maryland Univ., College Park, MD (USA)); Yao, R.L.; Destler, W.W. pp. 56 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184-: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Experimental results from Febetron generated electron beam transport in pure monatomic ion channels, demonstrate the development of IFR beam transport from space charge neutralization fractions in the range $0 > f_e$, 1.5. The plasma channel density was closely monitored by a Langmuir probe before each electron beam short. Efficient beam transport (60%) was observed in all gases for f_e values slightly grater than $1/\gamma^2$.

38281 **Ion channel transport systems for high current electron beam accelerators.** Miller, J.D. (Michigan Univ., Ann Arbor, MI (USA). Dept. of Nuclear Engineering); Gilgenbach, R.M.; Lucey, R.F.; Brake, M.L.; Repetti, T.E. pp. 54-55 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184-: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Two different ion channel generation systems have been employed. The first utilized a KrF excimer laser to preionize a channel in DEA (diethylaniline) gas at pressures from 0.1–1 m Torr. The second technique involves using a hot tungsten filament as a low voltage electron source. The filament is biased to – 300 V with respect to the drift tube wall and immersed in the mirror region of a weak, pulsed magnetic field. The plasma channel is then formed by matching the magnetic field at one end of the mirror to a low field (40 G) solenoid surrounding the transport tube. The background gas pressure in this case is low enough ($\{ <= \} 5 \times 10^{-5}$ Torr) that e-beam impact ionization from the REB is negligible. Ion channels, of 1 to 2 meter length, have been generated in argon, neon, krypton, and xenon to ensure a monatomic ion background. Plasma channels created in this manner are generally well defined with a radius of about 1.5 cm and maximum channel densities (controllable by the source discharge current and solenoidal magnetic field) up to 10^{11} cm^{-3}.

38282 **A micro-fabrication compatible wiggler design scalable to sub-millimeter periods.** Bluen, H. (Maryland Univ., College Park, MD (USA)); Jackson, R.H. pp. 53 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184-: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Free Electron Lasers (FELs) are attractive as high power tunable sources of coherent radiation in the millimeter wave and far-infrared regimes for such diverse applications as spectroscopy,

radar, and communications. To reach these high frequencies requires either high voltage operation or short wiggler periods. By utilizing ultra short wiggler periods the size and cost of the device can be greatly reduced, and CW operation becomes possible. Problems associated with higher voltages, such as x-ray shielding, can also be minimized. However, it is difficult to fabricate a short period wiggler which will provide the required field strengths, with adequate field uniformity.

38283 Lithium ion beam experiments on PBFA II. Woodworth, J.R. (Sandia National Labs., Albuquerque, NM (USA)); Pregenzer, A.L.; Bieg, K.W.; Lochner, T.R.; Gerber, R.A.; Johnson, D.J.; Leeper, R.J.; Maenchen, J.E.; Mehlhorn, T.A.; Ruiz, C.L. pp. 99 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). DOE Contract AC04-76DP00789. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The authors are fielding experiments on the Applied-B ion diode in Sandia's Particle Beam Fusion Accelerator II with the goal of generating and focusing intense lithium ion beams. The authors are investigating several lithium ion sources, including field-enhanced solid LiF, liquid lithium nitrate, and liquid Li. The field-enhanced LiF anodes are created by coating a thin (1–3 μm) layer of solid LiF over a rough, porous, stainless-steel frit.

38284 Design and initial operation of the Madison Symmetric Torus. Lovell, T.W. (Wisconsin Univ., Madison, WI (USA)); Dexter, R.N.; Feyzi, F.; Kortbawn, D.; Prager, S.C.; Sprott, J.C. pp. 79-80 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The Madison Symmetric Torus (MST) is a new, versatile reversed field pinch that began operation in June of 1988. MST was designed to operate anywhere in the region from tokamak to reversed field pinch. Initial operation has been as an RFP and has more than met design expectations. The device has consistently produced 500 kA, 34 mS discharges.

38285 Magnetic flux generation and sawteeth in the MST reversed-field pinch. Beckstead, J.A. (Wisconsin Univ., Madison, WI (USA)); Almagri, A.F.; Assadi, S.; Chartas, G.; Den Hartog, D.J.; Dexter, R.N.; Sarff, J.S.; Scime, E.E.; Shen, W. pp. 80-81 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The Madison Symmetric Torus (MST) is a reversed-field pinch (RFP) which began operation in June 1988 (major radius of 1.50 m and minor radius of 0.52 m). Since its initial operation, discrete magnetic disturbances have been observed which result in an increase in the average toroidal magnetic flux and a decrease in the toroidal field at the wall. These disturbances are well correlated with events on other diagnostics: a sharp drop in soft x-ray signals (similar to the tokamak sawteeth), a decrease in the line averaged density, an increase in the edge density, and an increase in wall interactions as seen by spectroscopic signals. The plasma column also experiences a sudden inward shift as seen by magnetic pickup coils.

38286 Fast rise-time magnetic field coil study. Weidman, D.J. (Naval Surface Warfare Center, Silver Spring, MD (USA)); Schnieder, R.F. pp. 81 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The preliminary design and testing of a fast magnetic field coil is presented. The present goal is a 3 cm diameter coil that will produce a magnetic field that changes by roughly 3 kG within 100 ns. The purpose of this coil is to impart a varying canonical angular momentum to a 700 keV, 100 kA, 100 ns electron beam produced by a field-emission cathode. This would tend to stabilize the resistive hose ($m = 1$) instability.

38287 Numerical and theoretical developments in plasma erosion opening switch research. Grossman, J.M. (Naval Research Lab., Washington, DC (USA). Plasma Physics Div.). pp. 41 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The plasma erosion opening switch (PEOS) is a fast opening vacuum switch that can conduct mega-ampere levels of current for 50 ns—1 μs before opening into a load. The opening times can be a factor of ten times smaller than the conduction times. This characteristic of time compression and consequent voltage multiplication may have application in future inductive energy storage devices for pulsed power. The short conduction time (<100 ns) PEOS is able to open fast (<10 ns) and couple to diode loads at the multi-megavolt, multi-terawatt level.

38288 Ion betatron. Rostoker, N. (Dept. of Physics, Univ. of California, Irvine, CA (US)). pp. 44 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

A modified betatron has previously been proposed for ions to increase the space charge limit. This limit is particularly restrictive for ions and a large toroidal magnetic field is required to increase the limit significantly. Another proposal that was studied was a collective focusing ion accelerator. This involved a series of Gabor lenses which electrostatically focused ions using the space charge fields of electrons. The magnetic field was that of a bumpy torus so that only ions would be accelerated and electrons magnetically insulated.

38289 Radiofrequency ionization of helium with turbulent flow-measurements versus theory. Talaat, M.E. (Maryland Univ., College Park, MD (USA)); Karditsas, P.J. pp. 37 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

This is because the dominant plasma processes were found to be made up of a two step ionization process consisting of collisional excitations of the ground state atoms by the tail electrons, followed by collisional ionizations of the metastable state atoms by the bulk electrons, a two body radiative and neutral assisted recombination process of the dominant molecular positive ions to atomic or molecular metastables, and a diffusion process which is primarily dependent on the turbulent diffusion coefficient. The measured applied voltage V_m, the computed plasma column voltage V^p (for a 2.2 cms long by 2.2 cms dia, 11 MHz discharge column), and the derived equivalent capacitive reactance voltage drop $V_{cx} = (V_m^2 - V_p^2)^{0.5}$, (for the 2.4 cms long external electrode regions), are plotted versus I, for two sets of test conditions: (a) p = 405.33 torr, T = 510.93 K, u = 484.66 m/s, and (b) p = 506.67 torr, T = 483.15 K, u = 449.13 m/s.

38290 The coaxial cavity locked HPM tube and external HPM feedback stabilization. Phelps, D.A. (IRT Corp., San Diego, CA (USA)). pp. 62 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The intensity of relativistic electron beam interactions in high power microwave (HPM) tubes has increased in recent years, complicating the physics with many interaction spoiling plasmas. The authors show that: dense electrode and cavity plasmas (borne of field emission, electron/ion bombardment, and electron/ion/x-ray initiated multi-pacting) are both sporadic and dynamic–rendering difficult efforts to produce coherent non-spiky 100 + ns HPM in sub-centimeter gap tubes; intense and dynamic ion beams steal

modulator energy and cause drastic modification of space charge field profiles; intense electron beam-wave interactions vary locally in a chaotic manner and suffer from poor HPM transmission and phase communication, due to dense magnetized electron plasma shielding and dielectric modification; applied magnetic fields, pulse risetime and low-ripple voltage plateau tuning is complicated by appreciable HPM fields and beam space charge and self-magnetic fields.

38291 Ash and burn control in ITER-type tokamak. Hu, S. (Illinois Univ., Urbana, IL (USA). Dept. of Nuclear Engineering); Varadarajan, V.; Miley, G.H. pp. 60-61 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

an analytic model for predicting the influence of sawteeth and edge pumping on the helium contamination has been developed. One of its uses is to compute the ash density level for a given fusion power vs. helium pumping fraction. The change of ash concentration due to sawteeth disruptions is also evaluated. The results show that the helium contamination can be changed dramatically if pumping is strong enough. However this pumping requirement varies according to the helium diffusion rate; and adequate helium pumping will be difficult to achieve. The results also show that adding sawteeth to help remove the ash from the center of the plasma becomes useful when the temperature profiles are parabolic or flatter. Several issues such as self-consistent plasma profiles, the helium pinch term, etc. are not included in the analysis. Thus a 1-1/2 D numerical study is in progress to address these issues. The analytical model predicts that careful modelling is needed in the regime where the helium recycling is large.

38292 Experimental and theoretical modeling of runaway electron damage for the design of tokamak plasma facing components. Niemer, K.A. (North Carolina State Univ., Raleigh, NC (USA). Dept. of Nuclear Engineering); Gilligan, J.G.; Croessmann, C.D. pp. 60 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). DOE Contract AC04-76DP00789. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Damage of tokamak components and materials due to high energy runaway electrons (20–150 MeV) during disruptions will be a critical factor in the design of near term and future tokamak experiments such as ITER. Some estimates of these run-away electrons predict energy depositions of 10–500 MJ/m^2 over a time scale of 50–500 msec. This project uses a computational model of the effect of the runaway electrons to predict the energy deposition and damage on tokamak first wall and limiter materials. The results from this model are used to design components which can withstand high energy runaway electron damage.

38293 High field, single turn toroidal magnet technology demonstrator for ignitex. Werst, M.D. (Texas Univ., Austin, TX (USA). Center for Electromechanics); Driga, M.D.; Hsieh, K.T.; Weldon, W.F. pp. 58 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The design philosophy of the magnet has been to use materials with the highest strength and electrical conductivity available and preload it as much as possible. Unlike conventional toroidal field coils that use multiple turns of the conductor, the single turn coil eliminates the need for turn-to-turn insulation and therefore better utilizes the available inner leg area for stress and thermal management. Pool cooling of the coil in liquid nitrogen permits the magnet to operate in a wider temperature regime without exceeding material strength properties. Beryllium copper has been selected as the material for the prototype ignitex TF coil. Based on present material's technology, the same material is recommended for the full scale ignitex.

38294 IGNITEX experiment. Carrera, R.; Barrington, M.; Bickerton, R.; Booth, D.; Chen, Y.; Dong, J.; Driga, M.; Eways, S.; Fu, G.; Gully, J. pp. 58 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The scientific and technological bases for the ignitex experiment have been developed during the last one and one half decades. The conclusion of the preliminary conceptual design carried out to date is that the ignitex concept has the potential to produce and control fusion ignition for scientific study at low cost. Some twelve papers in this conference describe the various aspects of the ignitex experiment.

38295 Nuclear radiation analysis of the IGNITEX experiment. Palmrose, D.E. (Texas A and M Univ., College Station, TX (USA). Dept. of Nuclear Engineering); Parish, T.A.; Carrera, R.; Hertel, N.E.; Miller, G. pp. 59 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

preliminary characterization of the radiological aspects of the proposed ignitex device will be reviewed. Improved neutron and photon transport modeling, to assess the fluxes in the vicinity of diagnostic ports and the effects of neutron streaming, using the two dimensional code twodant and the Monte Carlo method code MCNP are presented.

38296 Prospect of multiphoton induced inner shell excitations for x-ray laser pumping. Casperson, D.E. (Los Alamos National Lab., NM (USA). Physics Div.); Lee, P.H.Y.; Schappert, G.T. pp. 136 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

It is enticing to consider the possibility that the new class of modest energy, high brightness table-top lasers which are available today, could be used to pump a medium in an x-ray laser geometry. The ultra-high irradiances produced in the focal volumes of such lasers are known to generate multiphoton induced non-linear effects in target materials. One such effect which has received theoretical speculation is a direct coupling of laser induced outer shell electron motion to generate inner shell excitations in collisionless targets. This effect is predicted to become important at irradiances $I \gtrsim I_o$ where I_o is the laser irradiance corresponding to the optical field strength of an atomic unit $E_o = e/a_o^2$ or 3.5×10^{16} W/cm^2. Such an effect could form an inversion relevant to a soft x-ray lasing scheme.

38297 Beam studies in the L.B.L. MBE-4 device. Eylon, S. (Lawrence Berkeley Lab., CA (USA)); Meuth, H.; Johnson, R.; Hahn, K. pp. 134 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). DOE Contract AC03-76SF00098. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The multiple beam accelerator MBE-4 is a device for research toward a heavy ion driver for inertial confinement fusion, based on the induction linac concept. Its main goal is proof of the principle of current amplification by acceleration and controlled self-similar beam pulse compression. Into the 16-m long electrostatic alternate-gradient focussing lattice four beams are injected. Each carries an initial current of 10 mA of Cs + -ions from a Marx-driven diode at 200 keV. The achieved current amplification is up to nine-fold, with a final beam energy in excess of 800 keV in the middle of the current pulse. The apparatus was built and brought into operation in steps. All these accelerator sections have now been completed, installed and aligned, and a wide number of Linac beam experiments have begun. Available diagnostics include transverse double-slit emittance and position measuring devices; current-sensing Faraday cups; and electrostatic energy analysis. Diagnostic access is

possible along the entire device at a number of stations and is fully computer-controlled. Appropriate accelerator schedules were implemented to accomplish approximate self-similar current-pulse compression.

38298 Including electron-electron collisions in Monte Carlo simulations of swarms in partially ionized plasmas. Weng, Y. (Illinois Univ., Urbana, IL (USA). Gaseous Electronics Lab.); Kushner, M.J. pp. 131 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

In this paper, the authors discuss a new method whereby e-e collisions may be included in MCS's of electron swarms in low temperature partially ionized plasmas. The method is based on treating e-e collisions in a manner equivalent to electron-neutral collisions by using the impact approximation (instantaneous momentum exchange). This equivalency enables the direct inclusion of e-e collisions in the selection process used for collisions by the Monte Carlo method, and is obtained by having electrons collide with a background electron fluid. Momentum exchange occurs with the fluid, thereby requiring periodic updates of the EEDF of the background fluid. This method is made computationally feasible by use of a modified null cross section technique.

38299 Microsources of intense fusion in focused discharges of plasma focus. Bortolotti, A. (Stevens Inst. of Tech., Hoboken, NJ (USA)); Brzosko, J.S.; Fuschini, A.; Nardi, V.; Powell, C. pp. 105 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

High nuclear reactivity within submillimetric domains in the space structure of the pinch of focused discharges has been reported since many years. Now the authors summarize and compare new and previously published data from our experiments which describe the emission of D^+ beams and the occurrence of nuclear fusion reactions within submillimetric domains of plasma focus (PF) discharges for W = 5–10 kJ PF machines operating in the neutron optimized mode.

38300 Theoretical study of stability analysis for relativistic planar magnetron. Chen, H.C. (NSWC (US)); Uhm, H.S. pp. 122 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The diocotron stability properties have been analytically investigated by Davidson et al. According to the previous analytical study, the diocotron instability is completely stabilized when the inner or outer surface of the flow layer is in contact with the cathode or anode, respectively. In the numerical simulation, the authors have demonstrated stability of the diocotron perturbation in the case of the layer in contact with the cathode.

38301 Vacuum ultraviolet radiation from neon implosions. Young, F.C. (Naval Research Lab., Washington, DC (USA). Plasma Physics Div.); Stephanakis, S.J.; Welch, B.L.; Griem, H.R. pp. 167 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

A neon gas-puff z-pinch, driven by a 5-kJ capacitor bank discharge, is being used to determine experimentally the conditions required to produce a neon plasma with ions predominately in the NeIX ground state. Theoretical calculations for Na/Ne photopumping have indicated that neon temperatures of 50–100 eV and ion densities of 5×10^{17} cm^{-3} to 10^{19} cm^{-3} are required.

38302 Poloidal field electromagnetic engineering design for the TEXT upgrade. Li, G. (Texas Univ., Austin, TX (USA). Fusion Research Center); Zhu, W.; Edmonds, P.H.; Solano, E.R. pp. 163-164 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

The overall design is a compromise between the requirement of maximum flexibility for plasma configuration, the technological limitations of materials and fabrication techniques, protection against failure by disruption, and the inevitable requirement of minimum cost and early completion schedules. Highlights of the design include the use of a pinned and clamped multi-turn toroidal joint, the use of an alumina dispersed high strength copper alloy and protection against the very high mechanical forces. The overall structure consists of the poloidal half windings clamped and fiber-glass epoxy glued to fiber-glass half cylinders, which are attached to the torque frame structure by vertical studs. The diverter coils require water cooling, and because of the small cross-section area available for these cooling tubes and for the coil feeds, and intricate assembly procedure has been developed.

38303 Research on multiple-beam induction linacs for heavy ion inertial fusion. Fessenden, T.J. (Lawrence Berkeley Lab., CA (USA)). pp. 134 of Proceedings of the 1989 IEEE international conference on plasma science (Abstracts). IEEE Service Center, Piscataway, NJ (USA) (1989). DOE Contract AC03-76SF00098. (CONF-8905184–: Institute of Electrical and Electronics Engineers international conference on plasma science, Buffalo, NY (USA), 22-24 May 1989).

Since October 1983, research in the U.S. toward the development of a heavy ion inertial fusion driver has focused on the multiple-beam induction linac. Most of this work is performed at LBL under the Heavy Ion Fusion Accelerator Research program. The HIFAR program strategy is to address the key issues of induction linacs through theory and simulation and a sequence of experiments of increasing scale and sophistication.

38304 Transverse modulational instability of collinear waves. Luther, G.G. (Laboratory for Laser Energetics, 250 East River Road, Rochester, New York 14623 (US)); McKinstrie, C.J. *Journal of the Optical Society of America, Part B: Optical Physics (USA)*, 7(6): 1125-1141 (Jun 1990). DOE Contract FC03-85DP40200.

The transverse modulational instability, or filamentation, of two collinear waves is investigated using a coupled nonlinear Schro@;udinger-equation model. For infinite media it is shown that the presence of the second laser field increases the growth rate of the instability and decreases the scale length of the most unstable filaments. Systems of two copropagating waves are shown to be convectively unstable and systems of two counterpropagating waves are shown to be absolutely unstable, even when the ratio of backward- to forward-wave intensity is small. For two counterpropagating waves in finite media, the threshold intensities for the absolute instability depend only weakly on the ratio of wave intensities. The general theory is applied to the pondermotive filamentation of two light waves in homogeneous plasma.

38305 Nonlinear theory of intense laser-plasma interactions. Sprangle, P. (Beam Physics Branch, Plasma Physics Division, Naval Research Laboratory, Washington, D.C. 20375-5000 (USA)); Esarey, E.; Ting, A. *Physical Review Letters (USA)*, 64(17): 2011-2014 (23 Apr 1990).

A nonlinear theory of intense laser-plasma interactions is developed and used to describe relativistic optical guiding, coherent harmonic radiation production, and nonlinear plasma wakefield generation. Relativistic optical guiding is found to be ineffective in preventing the leading portion ($\leq$ a plasma wavelength) of a laser pulse from diffracting. Coherent harmonic generation is found to be most efficient for short laser pulses. Optical guiding and harmonic generation may be enhanced by the presence of large amplitude plasma wakefields. These phenomena may be important in laser-driven plasma accelerators, x-ray sources, and fusion schemes.

38306 Effect of barrier layers in burnthrough experiments with 351-nm laser illumination. Delettrez, J. (Laboratory for Laser Energetics, University of Rochester, 250 East River Road,

Rochester, New York 14623-1299 (US)); Bradley, D.K.; Jaanimagi, P.A.; Verdon, C.P. *Physical Review, A (General Physics) (USA)*, 41(10): 5583-5593 (15 May 1990). DOE Contract FC03-85DP40200.

The time-resolved x-ray emission is measured from spherical targets consisting of glass shells overcoated with plastic in which thin signature layers are embedded. These targets are illuminated at 351 nm by the 24-beam OMEGA laser system at the Laboratory for Laser Energetics of the University of Rochester. We measure a large burnthrough rate for bare plastic targets that can only be replicated in one-dimensional hydrodynamic simulations with laser intensities in excess of ten times the nominal intensity. We observe that the burnthrough times are affected by the presence of a thin outer coating (barrier layer). The burnthrough times depend strongly on the barrier-layer material and thickness, whereas one-dimensional simulation results predict only a small effect. Several processes are considered to explain these results: illumination nonuniformity, early shinethrough of the laser light through the plastic, prepulses, filamentation, self-focusing of hot spots, and the Rayleigh-Taylor instability. We conclude that mixing due to the Rayleigh-Taylor instability, enhanced by early shinethrough, is the most probable cause of the observed large burnthrough rates.

38307 **Evidence of hydrodynamic processes in multi-megampere copper fuses.** Lindemuth, I.R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (USA)); Caird, R.S.; Goforth, J.H.; Oona, H.; Reinovsky, R.E. *Journal of Applied Physics (USA)*, 67(11): 7111-7114 (1 Jun 1990).

Experiments have been performed in which an explosively formed fuse transferred a fraction of the 10 MA output current from an explosively powered magnetic flux compression generator to a conventional exploding metallic fuse load. System malfunctions significantly reduced the current delivered to the load and changed the fuse performance. The resultant slowing of the fuse material's trajectory through density-temperature space allowed a correlation between optical and electrical diagnostics which indicated a significant delay between the onset of hydrodynamic motion and the onset of rapid resistance increase. The experiments have confirmed a computational model of the fuse load hydrodynamic behavior.

38308 **Deuteron polarization of solid DT.** Souers, P.C. (Chemistry and Materials Science, Lawrence Livermore National Laboratory, Livermore, California 94550 (USA)); Fedders, P.A. *Physical Review, B: Condensed Matter (USA)*, 41(13): 8643-8651 (1 May 1990). DOE Contract W-7405-ENG-48.

Various possible means of attaining a large nuclear polarization of deuterons in solid deuterium tritide (DT) for use as a hydrogen-fusion fuel are considered. It is noted that dynamically polarized nuclear targets have reached only 40% polarization for deuterons despite there being no theoretical limit. In contrast, protons have been polarized to almost 100%. We consider dynamic nuclear polarization using both electrons as the pumping source (EDNP) and nuclei (NDNP). Most polarized targets have worked by EDNP thermal mixing. If protons are present, they bleed off part of the polarization intended for the deuterons. In a pure deuterated material, the smaller deuteron magnetic moment has so far prevented adequate nuclear cooling. The method most likely to work is the EDNP solid-state effect, which requires a narrow ESR spectrum for the atoms in solid DT. Should the tritons be polarized, their polarization can be transferred to the deuterons. Using NDNP thermal mixing, again, only 40% deuteron polarization is obtained. Using the NDNP solid-state effect and many polarization cycles, over 90% is achieved. The calculations offer optimism regarding deuteron polarization as far as the state of present knowledge of the properties of solid DT is concerned.

99 GENERAL AND MISCELLANEOUS

38309 (EP-CRG-RA–1988) **Management research.** Berry, M. (Centre National de la Recherche Scientifique (CNRS), 75 - Paris (FR)). Ecole Polytechnique, 91 - Palaiseau (France). 1988. 31p. (In French). Order Number DE90500873. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the Management Research center (Polytechnic School, France), is presented. The Center research programs include the management of different organizations, such as industry, administrative systems, hospitals and cultural systems. The investigations performed concern the improvement and better knowledge of the new methods of analysis: the role of the speech, the logic conflicts; the crisis development, symptoms and effects; the relationship between the management practices and the prevailing ideas or theories. The approach adopted by the scientists involves the accurate analysis of the essential management activities. The investigations carried out in 1988 are summarized. The published papers, the congress communications and the thesis are listed.

9901 Management

Refer also to citation(s) 36798

38310 (IAN–1984) **Progress report 1984.** Instituto de Asuntos Nucleares, Bogota (Colombia). 1985. 40p. (In Spanish). Order Number DE90631565. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The document informs about the activities made by the Institute of Nuclear Affairs (Colombia) during 1984 for each one of the technical areas: Agriculture, Industrial Applications and Metallurgy, Biochemistry and Radiopharmacy, Process Development, Electronics, Solar Energy, Gamma Facility, Nuclear Physics, Hydrology, Raw Materials, Chemistry, Health Physics, Reactor, and Library and Publications.

38311 (IAN–1987) **Progress report 1987.** Instituto de Asuntos Nucleares, Bogota (Colombia). 1988. 50p. (In Spanish). Order Number DE90631566. Available from NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS.

The document informs about the activities made by the Institute of Nuclear Affairs (Colombia) during 1987 for each one of the technical areas: Agriculture, Industrial Applications and Metallurgy, Biochemistry and Radiopharmacy, Process Development, Electronics, Solar Energy, Gamma Facility, Nuclear Physics, Hydrology, Raw Materials, Chemistry, Health Physics, Reactor, and Library and Publications.

38312 (IAN–1988) **Progress report 1988.** Instituto de Asuntos Nucleares, Bogota (Colombia). 1989. 54p. (In Spanish). Order Number DE90631567. Available from NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS.

The document informs about the activities made by the Institute of Nuclear Affairs (Colombia) during 1988 for each one of the technical areas: Agriculture, Industrial Applications and Metallurgy, Biochemistry and Radiopharmacy, Process Development, Electronics, Solar Energy, Gamma Facility, Nuclear Physics, Hydrology, Raw Materials, Chemistry, Health Physics, Reactor, and Library and Publications.

38313 (SAND–90-1215C) **Information engineering: Sandia's Computer Integrated Manufacturing (CIM) database.** Sharp, J.K. Sandia National Labs., Albuquerque, NM (USA). [1990]. 15p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900837–3: ASME international conference on computers in engineering, Boston, MA (USA), 5-9 Aug 1990). Order Number DE90009747. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The activities involved in establishing a Computer Integrated Manufacturing (CIM) database at Sandia National Laboratories (SNL) are part of a common effort to implement a proactive data administration function across administrative and technical databases. Data administration activities include the establishment of corporate data dictionary, a corporate information model, and a library of important objects and their relationships with other objects. Processes requiring information will be identified and supported with future information systems that share administrative and technical data. The process to create databases is being established based upon accepted engineering design practices. This paper discusses the CIM database, presents the selected information modeling technique and describes the information engineering process. 9 refs.

9902 Mathematics and Computers

Refer also to citation(s) 36714, 36729, 36741, 36763, 36776, 36784, 36788, 36795, 36802, 36844, 36848, 36849, 36880, 36882, 36884, 36893, 36904, 36911, 36917, 36921, 36922, 36941, 36949, 36964, 36967, 36968, 36969, 36980, 36982, 36987, 36989, 37008, 37132, 37134, 37135, 37156, 37159, 37289, 37301, 37335, 37373, 37377, 37378, 37382, 37388, 37399, 37401, 37402, 37499, 37536, 37537, 37545, 37546, 37547, 37551, 37557, 37566, 37640, 37836, 37953, 38030, 38053, 38345, 38346

38314 (CEA-CONF–9776) **Software supervisor: extension to the on-line codes utilization in order to help the process control.** Thomas, J.B.; Dumas, M.; Evrard, J.M. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI). 1988. 12p. (In French). (CONF-8810510–: Meeting on expert systems and on line codes for process operating assistance, Gif-sur-Yvette (France), 6 Oct 1988). Order Number DE90500824. Available from NTIS (US Sales Only), PC A03/MF A01.

Calculation is a complex problem, which is usually solved by human experts. The complexity and the potentiality of the software increases. The introduction of the calculations in real time systems needs additional specifications. These aims cab be achieved by means of the control of the knowledge based systems, as well as by the introduction of the software techniques in the existing computer world. The following examples are given: the automatic generation of the calculation methods (in control language) in the modular code systems; the calculations monitoring by the expert systems, in order to help the on-line operations.

38315 (CONF-900874–2) **Parallel programming with algorithmic skeletons.** Foster, I.; Stevens, R. Argonne National Lab., IL (USA). [1990]. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From 1990 international conference on parallel processing; St. Charles, IL (USA); 13-17 Aug 1990. Order Number DE90010536. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We describe an approach to parallel program development based on the use of algorithmic skeletons: templates for parallel algorithms, into which users slot application-specific routines to construct parallel programs. Key features of our proposal are the use of a high-level notation to express concurrent algorithms and the use of automated source-to-source transformations to implement skeletons. These features support the construction of new skeletons from old by both modification and composition. This in turn encourages an exploratory programming style, in which programmers experiment to develop good parallel implementations of applications. The use of a high-level notation encourages the user to view libraries of skeletons as archives expertise that can be consulted, modified, and extended when developing parallel programs. We illustrate the application of the approach using examples. 11 refs., 8 figs.

38316 (CONF-9005227–1) **A decision support system based on stochastic comparisons.** Uppuluri, V.R.R. Oak Ridge National Lab., TN (USA). [1990]. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Workshop on decision support methods for the electric power industry; Boston, MA (USA); 29-31 May 1990. Order Number DE90012783. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Suppose we have k objects and wish to rank them according to a characteristic. A judge compares these objects two at a time and indicates whether one object is better or worse or equal to another object. We analyze this data by log least squares procedure and the λ_{max} procedure suggested by Saaty. We show by examples, how one can incorporate the data from several judges to obtain a ranking of the objects. Finally, we consider the case when a judge compadres the objects two at a time and indicates the probability that one object is better than another object, and show how one can get a ranking of the objects. 6 refs.

38317 (CONF-9008101–2) **Estimating the parameters of a sporadically observed queue.** Barker, L.E. (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)); Ramey, D.B.; Song, Miyong. Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA). [1990]. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-89NV10630. From American Statistical Society; Anaheim, CA (USA); 20-24 Aug 1990. Order Number DE90012903. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Let X(t) be the number of customers in a queue at time t. Assume the queue is either M/M/1 or M/M/∞. Suppose we count the number of customers x_i at times $t_0 < t_1 < \cdots < t_n$, where t_i's do not depend on the number of customers in the queue. Write $u_i = t_i - t_{i-1}$. Let λ/μ. We estimate λ and μ, by maximizing the likelihood function. First we'll present the likelihood function and then discuss the maximization problem.

38318 (EP-LIX-RA–1988) **Data processing.** Cousot, P. Ecole Polytechnique, 91 - Palaiseau (France). 1988. 20p. (In French). Order Number DE90500871. Available from NTIS (US Sales Only), PC A03/MF A01.

The 1988 progress report of the Data Processing laboratory (Polytechnic School, France), is presented. The laboratory research fields are: the semantics, the tests and the semantic analysis of the codes, the formal calculus, the software applications, the algorithms, the neuron networks and VLSI (Very Large Scale Integration). The investigations concerning the polynomial rings are performed by means of the standard basis approach. Among the research topics, the Pascal codes, the parallel processing, the combinatorial, statistical and asymptotic properties of the fundamental data processing tools, the signal processing and the pattern recognition. The published papers, the congress communications and the thesis are also included.

38319 (KCP–613-4278) **Integrating expert systems with solid modeling through interprocess communications and the applications interface specification.** Hummel, K.E.; Wolf, M.L. Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Mar 1990. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00613. (CONF-900837–4: ASME international conference on computers in engineering, Boston, MA (USA), 5-9 Aug 1990). Order Number DE90012996. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Arguably the most elusive problems to automate in engineering are those that require a large degree of spatial reasoning. One of the most significant reasons for this has been the lack of appropriate software tools with which to perform research and development. The optimal software environment should integrate the symbolic reasoning capabilities of an expert system with the analytic reasoning capabilities of a solid modeling system. This paper describes such an environment, developed using interprocess communications and a standarized solid modeling interface language. This integration has resulted in a seamless coupling that provides an expert system with dynamic access to the full power of a solid modeling system. The details of the interprocess communications protocol, the solid modeling interface language, and the data dependency tracking technique are discussed. 10 refs., 5 figs.

38320 (LA-UR–89-3474) **OMNI development of an engineering product data management system.** Miranda, A.S. (RIM Technology, Inc., Issaquah, WA (USA)); Locke, T.M. Los Alamos National Lab., NM (USA). [1989]. 28p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-900837–1: ASME international conference on computers in engineering, Boston, MA (USA), 5-9 Aug 1990). Order Number DE90002407. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The increasing use of computers in engineering design and manufacturing (CAD/CAM) has been accompanied by the need to effectively manage the data produced, and the applications that produce the data. This paper presents an integrated engineering product data management system (PDMS) called OMNI. OMNI manages the product data, and controls access to the various CAD/CAM applications used to produce engineering data. OMNI is based on a relational data base (RTIRIM) and a FORTRAN interface between the data base, the operating system, and the engineering application programs. 9 refs., 6 figs.

38321 (ORNL–6572) **On the implementation of complex many-to-many relations in focus.** Ng, V. Oak Ridge National

Lab., TN (USA). Apr 1990. 33p. Sponsored by Environmental Protection Agency. DOE Contract AC05-84OR21400. Order Number DE90011300. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Resource Conservation and Recovery Act (RCRA) gives the US Environmental Protection Agency (EPA) the authority to regulate the generation, transportation, storage, treatment and disposal of hazardous wastes. Under a US Department of Energy/EPA interagency agreement, the Oak Ridge National Laboratory was assigned the responsibility of designing a distributed information system for EPA to facilitate the reporting of RCRA data from implementers to program management. One of the core automation needs was to develop an automated event tracking system for the RCRA compliance monitoring and enforcement (CM&E) program. The CM&E functions require data with complex many-to-many (N:M) relationships. Due to EPA policy, FOCUS was chosen to be the prototype development tool. This report describes the approach and the difficulties encountered in using FOCUS to implement an N:M relation. 8 refs., 22 figs.

38322 (ORNL/FTR–2923) **[Conference on vector and parallel computing]: Foreign trip report, May 31, 1988–June 14, 1988.** Drake, J.B. Oak Ridge National Lab., TN (USA). 29 Jun 1988. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012368. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler presented talks at both Eindhoven University of Technology and FOM Institute for Plasma Physics and discussed computational physics problems with staff members. Of particular interest to ORNL fusion researchers are the upcoming studies of plasma instabilities to be conducted at Utrecht. The traveler participated in the conference on vector and parallel computing where experience on a wide variety of vector and parallel machines was reported. The conference themes included computational fluid dynamics, oil reservoir simulation, linear algebra, visualization and parallel programming environments. The traveler also toured the computing facilities of CMI and BSC in Bergen and held discussions with researchers there about problems of common interest to researchers in a parallel computing at ORNL.

38323 (ORNL/FTR–2981) **[Optimal design and analysis of experiments]: Foreign trip report, July 22–29, 1988.** Morris, M.D. Oak Ridge National Lab., TN (USA). 9 Aug 1988. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012382. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the First International Conference Workshop on Optimal Design and Analysis of Experiments, and presented an invited paper entitled "A Bayesian Approach to the Design and Analysis of Computational Experiments" (joint with T. J. Mitchell of ORNL). Besides the traditional topics usually covered at design conferences, two general areas of research which were heavily represented are design and analysis techniques related to process quality assurance, and design criteria and procedures for prediction and estimation problems involving "spatially" correlated stochastic processes. The latter topic is particularly relevant to ORNL's effort in experimental design for computer experiments.

38324 (ORNL/FTR–2998) **[Optimal design and analysis of experiments]: Foreign trip report, July 16–August 5, 1988.** Mitchell, T.J. Oak Ridge National Lab., TN (USA). 22 Aug 1988. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012365. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the First International Conference-Workshop on Optimal Design and Analysis of Experiments, where he gave an invited paper, "A Bayesian Approach to the Design and Analysis of Computer Experiments (DACE)", jointly with M. D. Morris. Conference topics of particular interest to ORNL's Computational Statistics research were DACE, spatial correlation models, and computer algorithms for construction of experimental designs. The traveler also gave seminars on DACE at IBM's Bergen Scientific Centre and at the University of Augsburg. At Bergen, the traveler met with L. J. Gray and discussed the potential application of DACE methodology to the solution of differential equations. After the Conference, the traveler spent one week in London working with Professor H. P. Wynn of City University on maximum entropy sampling, a principle of experimental design that is of importance to ORNL's research in DACE.

38325 (ORNL/FTR–3038) **[Symposium on the Analytic Hierarchy Process]: Foreign trip report, September 2, 1988–September 11, 1988.** Uppuluri, V.R.R. Oak Ridge National Lab., TN (USA). 22 Sep 1988. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012360. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Analytic Hierarchy Process (AHP) is a methodology proposed by T.L. Saaty, USA, in 1977, in finding solutions to unstructured decision problems. This first International Symposium was sponsored by the Systems Engineering Society of China, the Operations Research Society of China, the Operations Research Society of Japan, and the National Science Foundation of the USA. This symposium was held at Tianjin University, Tianjin, China, during September 6–9, 1988. There were more than 160 participants, with about 15 from the United States, 7 from Japan, one from USSR, one from Finland, and one from Canada. During the last three years, this methodology was used extensively in the People's Republic of China by decision makers, and books are published on this topic along with the development of computer software. More than 200 papers seem to be in print. The Program Committee, of which I am a member, recommended to hold the Second International Conference on AHP in 1991 at Pittsburgh, Pennsylvania, USA. The latest developments summarized by computer software experts are relevant to the CO_2 Project and CASE Tools Project at Oak Ridge.

38326 (ORNL/FTR–3039) **[Automation and new technology]: Foreign trip report, August 31, 1988–September 12, 1988.** Burtis, C.A. Oak Ridge National Lab., TN (USA). 21 Sep 1988. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012310. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

I presented a plenary lecture and attended the Third International Congress on Automation and New Technology in the Clinical Laboratory. In addition, I visited a hospital laboratory that featured the use of robots for clinical applications and attended the 20th Annual Meeting of the Japan Society of Clinical Laboratory Automation. Prior to attending the two congresses, I chaired the Annual Meeting of the Committee on Analytical Systems of the International Federation of Clinical Chemistry. Current and future projects were discussed and planned, and nominations were made for new members.

38327 (ORNL/FTR–3103) **[International conference on free and moving boundary problems]: Foreign trip report, October 9, 1988–October 23, 1988.** Wilson, D.G. Oak Ridge National Lab., TN (USA). 3 Nov 1988. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012273. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The conference consisted of audiovisual presentations and discussions eight hours per day for three full days spread over four and one half days. A wide range of free and moving boundary problems was presented. All the talks except those given by the traveler and by Krystyna Twardowska were in Spanish. The traveler attended all presentations. However, his Spanish is limited and it was totally inadequate for the rapid rate at which most of these presentations were delivered. He could, of course, follow the gist of presentations accompanied by adequate visual material. In particular, the presentations by Sr. Bouillet, on a variational inequality governing the distribution of energy in mushy regions, and by Sr. Vicente, on metallurgical aspects of alloy solidification, were understood and appreciated. The traveler gave two talks. The first was on an implicit finite difference discretization of the enthalpy method, and the second was on the application of this scheme to a multidimensional phase change problem involving a significant change in density on freezing.

38328 (ORNL/FTR–3162) **[Computer vision and robotics]: Foreign trip report, January 22, 1989–January 28, 1989.** Jones, J.P. Oak Ridge National Lab., TN (USA). 13 Feb 1989. 9p.

Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE90012389. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the Fourth Aalborg International Symposium on Computer Vision at Aalborg University, Aalborg, Denmark. The traveler presented three invited lectures entitled, "Concurrent Computer Vision on a Hypercube Multicomputer", "The Butterfly Accumulator and its Application in Concurrent Computer Vision on Hypercube Multicomputers", and "Concurrency in Mobile Robotics at ORNL", and a ten-minute editorial entitled, "It Concurrency an Issue in Computer Vision." The traveler obtained information on current R&D efforts elsewhere in concurrent computer vision.

38329 (ORNL/M–1121) **Automated sensitivity analysis with the Gradient Enhanced Software System (GRESS).** Horwedel, J.E. Oak Ridge National Lab., TN (USA). May 1990. 37p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE90011291. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

GRESS automates the implementation of the well-known adjoint method for performing a comprehensive sensitivity analysis of existing FORTRAN 77 computer models. The GRESS ADjoint matrix GENerator (ADGEN) option is used to calculate first derivatives and sensitivities of selected model results with respect to all input data. This report provides a small problem used to exercise most of the major program options for a GRESS/ADGEN application. A description of the input and output from each processing step as well as the method for controlling the application is presented. The report is designed to aid users of the GRESS ADGEN option. 6 refs., 4 figs., 2 tabs.

38330 (ORNL/TM–11477) **An improved method for one-way dissection with singular diagonal blocks.** Barlow, J.L. (Pennsylvania State Univ., University Park, PA (USA). Dept. of Computer Science); Vemulapati, U.B. Oak Ridge National Lab., TN (USA). Jun 1990. 20p. Sponsored by U.S. Department of Defense; U.S. DOE Energy Research; National Science Foundation. DOE Contract AC05-84OR21400. Grant CCR-8700172;AFOSR-88-0161;N0014-80-0517;N00024085-C-6041. Order Number DE90012041. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We consider matrices arising out of the one-way dissection method for solving large sparse systems of linear equations. The systems that we consider are those that may have singular diagonal blocks. Such systems arise in certain fluid flow problems. Gunzberger and Nicholaides proposed a method for resolving the singularity in the diagonal blocks. This method uses the Moore-Penrose pseudoinverse. We propose two improvements to the Gunzberger-Nicholaides procedure: the substitution of a weighted pseudoinverse for the Moore-Penrose pseudoinverse; a more elegant implementation of the back substitution procedure. A stability analysis of both our procedure and the Gunzberger-Nicholaides procedure is given. Both our analysis and empirical tests show that our method has better numerical stability properties than the Gunzberger-Nicholaides procedure. We also implement our procedure on Intel iPSC/1 Hypercube. Our improvement to the back substitution method makes the natural parallelism in the problem easier to exploit. 13 refs., 2 tabs.

38331 (ORNL/TM–11518) **Proceedings of the 1989 CESAR/CEA [Center for Engineering Systems Advanced Research/Commissariat a l'Energie Atomique] workshop on autonomous mobile robots (May 30–June 1, 1989).** Harber, K.S. (Oak Ridge National Lab., TN (USA). Center for Engineering Systems Advanced Research); Pin, F.G. Oak Ridge National Lab., TN (USA). Mar 1990. 416p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. (CESAR–90/15;CONF-8905329–: Proceedings of the 1989 CESAR/CEA workshop on autonomous mobile robots, Oak Ridge, TN (USA), 30 May - 1 jun 1989). Order Number DE90011283. Available from NTIS, PC A18/MF A01 - OSTI; GPO Dep.

The US DOE Center for Engineering Systems Advanced Research (CESAR) at the Oak Ridge National Laboratory (ORNL) and the Commissariat a l'Energie Atomique's (CEA) Office de Robotique et Productique within the Directorat a la Valorization are working toward a long-term cooperative agreement and relationship in the area of Intelligent Systems Research (ISR). This report presents the proceedings of the first CESAR/CEA Workshop on Autonomous Mobile Robots which took place at ORNL on May 30, 31 and June 1, 1989. The purpose of the workshop was to present and discuss methodologies and algorithms under development at the two facilities in the area of perception and navigation for autonomous mobile robots in unstructured environments. Experimental demonstration of the algorithms and comparison of some of their features were proposed to take place within the framework of a previously mutually agreed-upon demonstration scenario or " base-case." The base-case scenario described in detail in Appendix A, involved autonomous navigation by the robot in an a priori unknown environment with dynamic obstacles, in order to reach a predetermined goal. From the intermediate goal location, the robot had to search for and locate a control panel, move toward it, and dock in front of the panel face. The CESAR demonstration was successfully accomplished using the HERMIES-IIB robot while subsets of the CEA demonstration performed using the ARES robot simulation and animation system were presented. The first session of the workshop focused on these experimental demonstrations and on the needs and considerations for establishing "benchmarks" for testing autonomous robot control algorithms.

38332 (SAND–90-0795) **A human factors review of data entry devices.** Allen, H.W. Sandia National Labs., Albuquerque, NM (USA). Jun 1990. 36p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC04-76DP00789. Order Number DE90012009. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report provides system designers with basic human factors information and guidelines to help in the selection of manual data input devices. The selection of such devices is important with respect to the environment in which the device with be used, speed of data entry required, error potential, and the user friendliness of the candidate devices. The report reviews several of the most commonly used data input devices and provides a description of each, experimental evaluations, and observations and recommendations based on review of the data. In addition, the appendix presents an input device matrix that gives general guidance concerning input devices and the physical and mission environment in which they might be used. Additional assistance should be requested from Sandia National Laboratories (SNL) Human Factors Personnel. 23 refs., 13 figs.

38333 (SLAC-PUB–5241) **Object oriented programming.** Kunz, P.F. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Apr 1990. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-9004190–8: Computing in high energy physics, Santa Fe, NM (USA), 9-13 Apr 1990). Order Number DE90011797. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper is an introduction to object oriented programming techniques. It tries to explain the concepts by using analogies with traditional programming. The object oriented approach is not inherently difficult, but most programmers find a relatively high threshold in learning it. Thus, this paper will attempt to convey the concepts with examples rather than explain the formal theory. 2 refs., 11 figs.

38334 (SLAC-PUB–5242) **The Reason Project.** Atwood, W. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)); Blankenbecler, R.; Kunz, P.F.; Mours, B.; Weir, A.; Word, G. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Apr 1990. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-9003161–3: 25. Rencontres de Moriond on QCD and hadronic interactions conference; International workshop on software engineering, artificial intelligence and expert systems for high energy and nuclear physics; Computing in high energy physics, Les Order Number DE90011796. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Reason is a software package to allow one to do physics analysis with the look and feel of the Apple Macintosh. It was implemented on a NeXT computer which does not yet support the standard HEP packages for graphics and histogramming. This paper will review our experiences and the program. 2 refs., 2 figs.

38335 (UCID–21934) **Pixar data visualization tools overview.** Miller, M.C. Lawrence Livermore National Lab., CA (USA). 22 Jan 1990. 21p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE90013512. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This article explains how to perform basic visualization operations on the Pixar. The three main operations performed on the Pixar are interactive planometric rendering, video film loop production, volumetric rendering and some simple image processing. All these and other high-level visualization operations use a common data format for storing sets of images known as the Pixar Volume which is created using Makevol. A number of other low-level tools facilitating visualization operations are also introduced and summarized. 10 refs., 2 figs.

38336 (UCRL–21222) **Controlled eager evaluation in a Dynamic-Arc Tagged-Token Dataflow Model.** Mattson, J.S. Jr. (California Univ., San Diego, La Jolla, CA (USA). Dept. of Computer Science and Engineering); Vin, H.M.; Berman, F. Lawrence Livermore National Lab., CA (USA); California Univ., San Diego, La Jolla, CA (USA). Dept. of Computer Science and Engineering. 11 Sep 1989. 21p. Sponsored by U.S. Department of Defense; U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-900329–3: ACM SIGPLAN symposium on principles and practice of parallel programming, Seattle, WA (USA), 15-16 Mar 1990). Order Number DE90012866. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The data-driven execution scheme achieves parallelism by simultaneously activating all operations whose data is available. However, in a dataflow machine with limited resources, the data-driven scheme can lose efficiency when a significant amount of time is spent on the execution of useless computations. In this paper, we introduce a general dataflow model, the Dynamic-Arc Tagged-Token Dataflow Model, which extends traditional dataflow models to include dynamic arcs as a natural mechanism to implement function and procedure calls. Within this model, we develop the Efficient Data-Driven Evaluation Scheme which improves the performance of conventional data-driven execution by terminating useless computations at run-time. This is facilitated by the construction of an extended dataflow graph at compile-time in which useless computations can be identified dynamically. When useless computations are terminated, program execution times improve since more resources are available for the processing of computations which contribute to the final results. 12 refs., 9 figs.

38337 (UCRL–102655) **A scalable coherent cache system with fuzzy directory state.** Brooks, E.D. III.; Hoag, J.E. Lawrence Livermore National Lab., CA (USA). Jan 1990. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-900874–1: 1990 international conference on parallel processing, St. Charles, IL (USA), 13-17 Aug 1990). Order Number DE90007258. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We describe a directory based coherent cache system which can be scaled. Our scheme is an interpolation between the complete directory state solution of Censier and Feautrier, where the memory controller knows the disposition of the line for every cache, and the minimal state solution due to Archibald and Baer which requires broadcasts for all state transitions. By interpolating between these solutions we can limit the negative performance impact of broadcasts to caches which do not have a copy of the line. In our scheme, the N caches in the system are divided into N/G subgroups, where G is the group size, and a state bit is used to reflect occupancy information for each subgroup. The number of state bits required for each line can be scaled by appropriately selecting the group size. Multicasts of invalidate requests are limited to subgroups of caches which have one or more copies of the line. Our interconnection network efficiently supports multicasts to subgroups of caches, and combines the responses from these multicasts, to optimize performance. 10 refs., 3 figs.

38338 (UCRL–102856) **Depth buffer shadow algorithms.** Grant, C.W.; Allison, M.J. Lawrence Livermore National Lab., CA (USA). Feb 1990. 35p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-9008102–1: ACM SIGGRAPH '90, Dallas, TX (USA), 6-10 Aug 1990). Order Number DE90012070. Available from NTIS, PC A03/MF A01 - OSTI.

The depth buffer (also called z-buffer) visible surface algorithm is frequently used for shadow simulation. This shadow algorithm is very powerful, but it suffers from several problems such as aliasing and incorrect self-shadowing of simple surfaces. New algorithms are presented which solve these problems for most cases without much additional computation. A family of depth buffer shadow algorithms is defined. Three main improvements are presented. First, replacing the z-buffer with a p-buffer (plane buffer) gives a more accurate representation of the visible surface across a pixel. Second, storing two surface in the shadow buffer the closest and the second surfaces to the light source, and averaging them to form an intermediate surface yields a much better defined illumination test. Third, considering the values of adjacent pixels in the shadow buffer helps to reduce some aliasing artifacts. These techniques preserve all the desirable properties of the depth buffer visible surface algorithm while yielding more accurate shadows. 12 refs., 17 figs.

38339 (UCRL-JC–103855) **A scalable coherent cache system with incomplete directory state.** Brooks, E.D. III; Hoag, J.E. Lawrence Livermore National Lab., CA (USA). Apr 1990. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-900874–3: 1990 international conference on parallel processing, St. Charles, IL (USA), 13-17 Aug 1990). Order Number DE90010862. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We describe a directory based coherent cache system which can be scaled. Our scheme is an interpolation between the complete directory state solution by Censier and Feautrier, where the memory controller knows the disposition of the line for every cache, and the minimal state solution due to Archibald and Baer which requires broadcasts for certain state transitions. By interpolating between these solutions, and providing efficient hardware support, we can reduce the negative performance impact of broadcasts to caches which do not have a copy of the line. 7 refs.

38340 (UCRL-JC–104010) **Computer animation in mathematics, science and art.** Max, N.L. Lawrence Livermore National Lab., CA (USA). [1989]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8909342–1: Conference on computers in mathematics, Palo Alto, CA (USA), Sep 1989). Order Number DE90013051. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

At the conference whose proceedings make up this volume, my presentation consisted of a collection of excerpts from computer animated films. Since I showed only my own films, a description of my personal experiences in computer animation seems appropriate for this paper, with indications of the films shown at the conference, and where they can be obtained.

9903 Information Handling

Refer also to citation(s) 36907, 37004, 37031, 37127, 37128, 37162, 37186, 37187, 37188, 37342, 37343, 37344, 37345, 37346, 37403, 37751, 37989, 37990, 37991, 38025, 38318, 38320

38341 (CONF-900875–1) **A methodology for benchmarking distributed database management systems.** Orji, C.U. Argonne National Lab., IL (USA). [1990]. 24p. Sponsored by Veterans Administration. DOE Contract W-31109-ENG-38. From 16. international conference on very large databases; Brisbane (Australia); 13-16 Aug 1990. Order Number DE90007801. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A methodology for benchmarking distributed database management systems is proposed. A distributed environment is characterized in terms of the communication costs incurred in data movement between sites, the number of nodes that participate in processing a query and the data distribution scheme used in the network. These are used as a basis for identifying eight query types that capture the query performance characteristics in the network. Finally, an experimental outline is sketched to illustrate the steps in validating the methodology. 4 tabs.

38342 (EP-DLAB-RA–1988) **The direction of the laboratories.** Blanquet, S. (Centre National de la Recherche Scientifique

(CNRS), 75 - Paris (FR)). Ecole Polytechnique, 91 - Palaiseau (France). 1988. 26p. (In French). Order Number DE90500852. Available from NTIS (US Sales Only), PC A03/MF A01.

In the scope of the presentation of the 1988 Polytechnic School (France) research programs, the activities concerning each laboratory, are summarized. Several aspects of the programs are considered: the main projects, the results, the planned researches and the technical means. The personnel of the laboratory, their number in the different categories, the published papers, the patents and the thesis are included.

38343 (LA–11883-C) **Distance learning conference proceedings.** Alexander, J.B.; Andrews, A.E.; Hamer, N.D.; Keller, J.W.; Trainor, M.S. (comps.). Los Alamos National Lab., NM (USA). Jun 1990. 55p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE90011792. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This document reflects the content of the Distance Learning Conference sponsored by the Cognitive Systems Engineering Group, Analysis and Assessment Division, Los Alamos National Laboratory. The conference participants – highly respected representatives of military/government, industry, and academia – analyzed the potential of distance learning to deal with common educational problems. The group explored the distance learning problem, media, interactivity, instructional strategies, collective learning, student performance evaluation, and implementation of a national distance learning strategy. The conferees mandated a national initiative to implement distance learning in our country. Such a focused effort may help alleviate the current global education and training crisis. 50 refs.

38344 (LA-UR–90-1900) **It's not hype, It's communication: Using public relations techniques to improve your technical messages.** Martell, P.J. Los Alamos National Lab., NM (USA). [1990]. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-9009154–1: IEEE international professional communication conference, Guilford (UK), 12-14 Sep 1990). Order Number DE90012104. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Technical communicators are concerned that if they employ public relations (PR) techniques, they somehow compromise their work. They believe PR equates with type. However, to those of us in the field, PR means simply how people relate. Knowing PR techniques gives one a better understanding of human factors and interactions; using the techniques improves the chances for communication to occur. If technical communications are willing to learn PR techniques, they will gain strong tools to use to strengthen their messages.

38345 (SAND–89-2782C) **A protocol to set up shared secret schemes without the assistance of a mutually trusted party.** Ingemarsson, I. (Linkoeping Univ. (Sweden). Dept. of Electrical Engineering); Simmons, G.J. Sandia National Labs., Albuquerque, NM (USA). [1990]. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9005222–1: Eurocrypt '90, Aarhus (Denmark), 21-24 May 1990). Order Number DE90012159. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

All shared secret or shared control schemes devised thus far are autocratic in the sense that they depend in their realization on the existence of a single party–which may be either an individual or a device–that is unconditionally trusted by all the participants in the scheme. The function of this trusted party is to first choose the secret (piece of information) and then to construct and distribute in secret to each of the participants the private pieces of information which are their shares in the shared secret or control scheme. The private pieces of information are constructed in such a way that any authorized concurrence (subset) of the participants will jointly have sufficient information abut the secret to reconstruct it while no unauthorized collection of them will be able to do so. For many applications, though, there is no one who is trusted by all of the participants, and in the extreme case, no one who is trusted by anyone else. In the absence of a trusted party or authority, no one can be trusted to know the secret and hence–until now–it has appeared to be impossible to construct and distribute the private pieces of information needed to realize a shared control scheme. It is worth noting that in commercial and/or internation(al) applications, this situation is more nearly the norm than the exception. This document discusses the protocol for shared secret schemes in the absence of a trusted party or authority. 7 refs., 5 figs.

38346 (SAND–90-0690C) **A performance evaluation of biometric identification devices.** Holmes, J.P.; Maxwell, R.L.; Wright, L.J. Sandia National Labs., Albuquerque, NM (USA). Jun 1990. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-9007106–5: Institute of nuclear materials management conference, Los Angeles, CA (USA), 15-18 Jul 1990). Order Number DE90012917. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A biometric identification device is an automatic device that can verify a person's identity from a measurement of a physical feature or repeatable action of the individual. A reference measurement of the biometric is obtained when the individual is enrolled on the device. Subsequent verifications are made by comparing the submitted biometric feature against the reference sample. Sandia Laboratories has been evaluating the relative performance of several identity verifiers, using volunteer test subjects. Sandia testing methods and results are discussed.

38347 (SAND–90-1203C) **The EISI [Elemental and Interplanar Spacing Index] Index—A search/match tool for electron diffraction phase analysis.** Carr, M.J. (Sandia National Labs., Albuquerque, NM (USA)); Himes, V.L.; Mighell, A.D.; Anderson, R. Sandia National Labs., Albuquerque, NM (USA). [1990]. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-900877–3: 12. international congress for electron microscopy, Seattle, WA (USA), 12-18 Aug 1990). Order Number DE90010832. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The identification of unknown phases in the JCPDS-ICDD Powder Diffraction File (PDF) using diffraction data is a three-step process. First, the Search step rapidly screens the entire PDF to produce a list of candidate solutions that correspond to the unknown phase's d-spacings and chemistry. Second, the Match step examines closely every aspect of each phase in the candidate list, vs the unknown, to make the final identification. Third, the Decision step: Does the solution found make crystal-chemical-thermodynamic sense? A hindrance to the identification process for electron diffraction applications is that the PDF consists of x-ray diffraction powder data. The present Elemental and Interplanar Spacing Index (EISI) book is based on the successful 1979 Max-d/Alphabetical Index rules, but with significantly enhanced capability, as it utilizes the combined NIST/Sandia/ICDD Database. The EISI is designed to be used independently as a searching tool. As a searching tool it provides a list of candidate phases for consideration as solutions to the unknown phase diffraction data. The EISI index was designed to assist the actual steps taken by an Analytical Electron Microscope (AEM) diffractionist when confronted with an unknown diffraction dataset: the assemblage and d-spacing searching of a microfile of data containing chemically correct phases. The construction of the NIST/Sandia/ICDD Database overcomes many of the disadvantages associated with searching x-ray derived databases for solutions to electron diffraction problems. 8 refs., 1 fig.

Corporate Author Index

This index lists the corporate authors responsible for issuing the documents in this publication which are identified primarily by report number. The corporate names are entered in standardized forms as defined in *DOE Energy Data Base: Corporate Author Entries* (DOE/TIC-4585). Each entry under a corporate name includes the document title and citation number. Three items of information may appear in parentheses: (1) an abbreviation to identify the document type, such as a report; (2) the country of publication, also abbreviated; and (3) the language of the document if non-English (R;US;In French). Author affiliations are not listed in this index.

A

Acurex Corp., Research Triangle Park, NC (USA). Environmental Systems Div.
Theoretical approach for enhanced mass transfer effects in-duct flue gas desulfurization processes: Quarterly report No. 7, January 1, 1990–March 31, 1990, 15:36898 (R;US)

Advanced Sciences, Inc., Arlington, VA (USA)
Environmental assessment for 881 Hillside (High Priority Sites) interim remedial action, 15:36797 (R;US)

Aeronautical Research Inst. of Sweden, Bromma (Sweden)
Pressure measurements on a 5.35 m hawt in CARDC wind tunnel compared to theoretical pressure distributions, 15:36878 (R;SE)

Agence Francaise pour la Maitrise de l'Energie, 75 - Paris (France)
Dynamic tests of wind turbine metallic blades (Lamboley process), 15:36875 (R;FR;In French)
Heat pump and heliogeothermal space heating Aulnay-sous-Bois. The 1985 season, 15:36872 (R;FR;In French)
PIRSEM: 1987 operations review. Volume 1, 15:37045 (R;FR;In French)
PIRSEM: 1987 operations review. Volume 2, 15:37046 (R;FR;In French)
PIRSEM: 1987 operations review. Volume 3, 15:37020 (R;FR;In French)
Study and development of a mounted complier for wind turbines, 15:36876 (R;FR;In French)
Ten years of pilot technical applications of energy conservation in the industry, 15:37141 (R;FR;In French)

Air Force Geophysics Lab., Hanscom AFB, MA (USA)
Coordinated observations of high-latitude ionospheric turbulence, 15:37704 (R;US)

Aix-Marseille-3 Univ., 13 - Marseille (France)
Group contribution method for correlating and forecasting thermodynamic properties of petroleum fluids, 15:36738 (R;FR;In French)

Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.
Integrating expert systems with solid modeling through interprocess communications and the applications interface specification, 15:38319 (R;US)

AMAX Research and Development Center, Golden, CO (USA)
Ultra-fine coal characterization: Final report, 15:36689 (R;US)

American Gas Association, Inc., Arlington, VA (USA)
Investigation of sulfide-stress cracking at pipe seam welds, 15:36748 (R;US)

American Inst. of Architects, Washington, DC (USA)
Atrium building study, 15:37119 (R;US)

American Nuclear Society (USA). Fuel Cycle and Waste Management Div.
Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education: Volume 1, Overview and general waste management: Proceedings, 15:36772 (R;US)

American Society of Mechanical Engineers, New York, NY (USA)
Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education: Volume 1, Overview and general waste management: Proceedings, 15:36772 (R;US)

Ames Lab., IA (USA)
Fundamental studies of supported ruthenium catalysts: Model reaction studies and NMR [nuclear magnetic resonance] of adsorbed molecules, 15:36699 (R;US)
Kinetics of oxidation of cobalt(II) macrocyclic complexes by tris(bipyridyl)ruthenium(3+) ion, 15:37349 (R;US)
Mechanism and applicability of hydrolysis of peptides and proteins utilizing Pt(II) complexes, 15:37521 (R;US)
New selective anion-exchange resins for nitrate removal from contaminated drinking water and studies on analytical anion-exchange chromatography, 15:37616 (R;US)
Phase transitions in CsCl-type intemetallic compounds, 15:37190 (R;US)
Searching for heavy fermion materials in Ce intermetallic compounds, 15:37189 (R;US)
Selective electrocatalysis of anodic oxygen-transfer reactions at chemically modified, thin-film lead dioxide electrodes, 15:37235 (R;US)
Spectral hole burning and flourescence studies of a synthetic chlorophyll dimer, a bacterial antenna system and a bacterial reaction center, 15:36832 (R;US)
The oxidative coupling of methane by lanthanum oxide catalysts: The influence of phase morphology on catalytic properties, 15:37350 (R;US)
The reactivity of the thioalkyne, MeSC≡CSMe, with ruthenium and tungsten complexes, 15:37351 (R;US)

Argonne National Lab., Idaho Falls, ID (USA)
Consequences of metallic fuel-cladding liquid phase attack during over-temperature transient on fuel element lifetime, 15:36919 (R;US)
Real-time LMR control parameter generation using advanced adaptive synthesis, 15:36917 (R;US)

Argonne National Lab., IL (USA)
A comparison of direct control and market based policies for controlling emissions, 15:36709 (R;US)
A measurement-based method for predicting margins and uncertainties for unprotected accidents in the Integral Fast Reactor concept, 15:36960 (R;US)
A methodology for benchmarking distributed database management systems, 15:38341 (R;US)
An overview of the EBR-II PRA [Probabilistic Risk Assessment], 15:36956 (R;US)
Analysis of a DRACS [Direct Reactor Auxiliary Cooling System] test COMMIX validation, 15:36922 (R;US)
Analysis of metal fuel transient overpower experiments with the SAS4A accident analysis code, 15:36918 (R;US)
Consequences of pipe ruptures in metal fueled, liquid metal cooled reactors, 15:36957 (R;US)
Design of a reactor inlet temperature controller for EBR-2 using state feedback, 15:36937 (R;US)
EBR-II in-vessel natural circulation experiments on hot and cold pool stratification, 15:36963 (R;US)
Enhanced flue gas denitrification using ferrous EDTA and a polyphenolic compound having combined antioxidant and reducing properties, 15:36706 (R;US)
Environmentally assisted cracking in light water reactors: Semiannual report, October 1988–March 1989: Volume 8, 15:36906 (R;US)

Frequency response testing at Experimental Breeder Reactor II using discrete-level periodic signals, 15:36923 (R;US)
Fuel damage during off-normal transients in metal-fueled fast reactors, 15:36959 (R;US)
Fuel motions in the multi-pin PFR/TREAT test series, 15:36953 (R;US)
Fuel/cladding compatibility in irradiated metallic fuel pins at elevated temperatures, 15:36920 (R;US)
International competitiveness of clean coal technologies, 15:36717 (R;US)
Joint US/Japanese program of full-size building tests for base seismic isolation, 15:36958 (R;US)
Materials research issues in superconducting levitation and suspension as applied to magnetic bearings, 15:37227 (R;US)
Modeling developments for the SAS4A and SASSYS computer codes, 15:36921 (R;US)
Parallel programming with algorithmic skeletons, 15:38315 (R;US)
Performance of metal and oxide fuels during accidents in a large liquid metal cooled reactor, 15:36955 (R;US)
Quantitative studies of severe fuel damage using delayed neutron data, 15:36938 (R;US)
Recycling of plastics in automobile shredder residue, 15:37142 (R;US)
Run - Beyond - Cladding - Breach (RBCB) test results for the Integral Fast Reactor (IFR) metallic fuels program, 15:36946 (R;US)
Steady-state irradiation testing of U-Pu-Zr fuel to >18% burnup, 15:36924 (R;US)
The passive response of the Integral Fast Reactor concept to the chilled inlet accident, 15:36962 (R;US)
The reaction of glass during gamma irradiation in a saturated tuff environment: Part 4, SRL 165, ATM-1c, and ATM-8 glasses at 1E3 R/h and O R/h, 15:36764 (R;US)
Three-dimensional parametric study for MHD marine propulsion, 15:37155 (R;US)
Tomographic imaging of severely disrupted fuel assemblies tested in TREAT, 15:36916 (R;US)
Transient feedback from fuel motion in metal IFR [Integral Fast Reactor] fuel, 15:36954 (R;US)
Use of ferrous chelates for NO_x control in aqueous scrubbers, 15:36707 (R;US)
Utilization of off-peak electric power to improve cycle efficiency during peak demand periods, 15:36887 (R;US)
Whole-Pin Furnace system: An experimental facility for studying irradiated fuel pin behavior under potential reactor accident conditions, 15:36961 (R;US)

Argonne National Lab., IL (USA). Advanced Photon Source Div.
Workshop on high heat load x-ray optics, 15:37707 (R;US)

Argonne National Lab., IL (USA). Energy Systems Div.
Combined nitrogen oxides/sulfur dioxide control in dry scrubber systems: Volume 2, Evaluation of additives and process modifications: Appendixes, 15:36894 (R;US)
Combined nitrogen oxides/sulfur dioxide control in a spray-dryer/fabric-filter system: Summary report for the Field Research Program, 15:36895 (R;US)
Outlook for ceramics in heat engines, 1990–2010: A technical and economic assessment based on a worldwide Delphi survey, 15:37156 (R;US)
Spray-dryer flue-gas-cleaning systems handbook, 15:36892 (R;US)
User's guide for SDIS [Spray-Dryer Information System]: A personal computer code for the design and evaluation of spray-dryer flue-gas-cleaning systems, 15:36893 (R;US)

Arizona Univ., Tucson, AZ (USA). Coll. of Engineering and Mines
Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education: Volume 1, Overview and general waste management: Proceedings, 15:36772 (R;US)

Army Research Inst. of Environmental Medicine, Natick, MA (USA)
Effects of a modified through-mask drinking system (MDS) on fluid intake during exercise in chemical protective gear. Report for January-May 1989, 15:37558 (R;US)

Atmospheric and Environmental Research, Inc., Cambridge, MA (USA)
Simulating climate with two different numerical schemes, 15:37565 (R;US)

Atomic Energy Commission, Damascus (Syria)
Radiation protection glossary, 15:37936 (R;SY;In Arabic)

Atomic Energy Control Board, Ottawa, ON (Canada)
Microcomputer based program for predicting heat transfer under reactor accident conditions. Volume I: Text, 15:36913 (R;CA)

Australian National Univ., Canberra (Australia). Dept. of Nuclear Physics
Conversion coefficients and yrast state spins in ^{180}Os, 15:37875 (R;AU)
Fission fragment angular distributions following transfer reactions for $^{232}Th + {}^{16}O$, 15:37884 (R;AU)
High spin states and intrinsic structure in ^{174}Os and ^{175}Os - alignments and strong interaction, 15:37874 (R;AU)
Intrinsic states and rotational bands in ^{177}Pt, 15:37873 (R;AU)
Study of ^{19}N and ^{21}O by multinucleon transfer, 15:37850 (R;AU)
The populations of Rydberg states of ions emerging from solid surfaces, 15:37708 (R;AU)

B

Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div.
Physical flow model study of the Ohio Power Company's 12-MW duct injection test facility in Beverly, Ohio: Topical report 10A, 15:36896 (R;US)

Battelle Columbus Div., OH (USA)
A modified criterion for evaluating the remaining strength of corroded pipe: Final report, 15:36749 (R;US)

Battelle, Columbus, OH (USA)
Ductile fracture properties of selected line-pipe steels, 15:36747 (R;US)
Investigation of sulfide-stress cracking at pipe seam welds, 15:36748 (R;US)
The use of flattened specimens to measure the Charpy V-notch impact properties of thin-wall pipe, 15:36746 (R;US)

Bechtel Group, Inc., San Francisco, CA (USA)
Slurry reactor design studies: Topical report, Reactor selection criteria, 15:36697 (R;US)

Boeing Aerospace Co., Kent, WA (USA)
Multimegawatt space nuclear power supply: Phase 1, Final report: Volume 2, Phase 2 plan, 15:36929 (R;US)
Multimegawatt space nuclear power supply: Phase 1, Final report: Volume 3, Annotated outline of preliminary safety assessment, 15:36930 (R;US)
Multimegawatt space nuclear power supply, Phase 1 Final report: Supplement D180-30619-8, 15:36931 (R;US)

Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet
Calibration simulation. A calibration Monte-Carlo program for the OPAL jet chamber, 15:37511 (R;DE;In German)
Construction and test of the Bonn frozen spin target, 15:37465 (R;DE;In German)

Bonn Univ. (Germany, F.R.). Physikalisches Inst.
Calibration simulation. A calibration Monte-Carlo program for the OPAL jet chamber, 15:37511 (R;DE;In German)
Construction and test of the Bonn frozen spin target, 15:37465 (R;DE;In German)

Bordeaux-1 Univ., 33 (France)
Horizontal vibrations of piles in a centrifuge, 15:37398 (R;FR;In French)

Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires
Classical model for α-particle emission during nuclear fission, 15:37891 (R;FR)
High resolution measurements of mass, energy and nuclear charge correlations for ^{229}Th (n_{th}, f) with the Cosi Fan Tutte spectrometer, 15:37892 (R;FR)

Brandeis Univ., Waltham, MA (USA). Dept. of Physics
Research in elementary particle physics: Technical progress report, June 1, 1989–May 31, 1990, 15:37753 (R;US)

Brookhaven National Lab., Upton, NY (USA)
A search for long-lived low mass states coupling to e^+e^-, 15:37825 (R;US)
An initial comparison of pitting resistance of alloys for potential geothermal applications, 15:36869 (R;US)
Charged particle distributions in heavy ion collisions at 14.6 GeV A/c, 15:37824 (R;US)
Figure and finish of grazing incidence mirrors, 15:37280 (R;US)
Heat transfer between stratified liquids with bubbling across the interface, 15:37392 (R;US)
Instrumental effects in surface finish measurement, 15:37537 (R;US)
International safeguards: Accounting for nuclear materials, 15:36809 (R;US)
Proceedings of the CAP [Center for Accelerator Physics] meetings, October 1989–April 1990, 15:37430 (R;US)
Prospects for thermophilic microorganisms in microbial enhanced oil recovery (MEOR), 15:36723 (R;US)
Simplified analysis of PRISM RVACS [Reactor Vessel Auxiliary Cooling System] performance without liner spill-over, 15:36914 (R;US)
Testing methodologies, 15:37663 (R;US)
The use of high-energy synchrotron radiation for x-ray scattering, 15:37510 (R;US)
Zircaloy cladding performance under spent fuel disposal conditions: Progress report, May 1–October 31, 1989, 15:36766 (R;US)

Brown (John) E and C, Inc., Casper, WY (USA)
Naval Petroleum Reserve No. 3, Naval Oil Shale Reserves Nos. 1, 2, 3: Site environmental report, CY 1989, 15:37564 (R;US)

Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.)
Application of the finite-element program NAMMU for a model of a radioactive waste repository site, 15:36765 (R;DE;In German)

C

Calgary Univ., AB (Canada). Dept. of Mechanical Engineering
Dynamics of the Ross-Stirling engine, 15:37401 (R;CA)
Ross-Stirling engines: Variations on a theme, 15:37400 (R;CA)

California Univ., Berkeley, CA (USA). Coll. of Engineering
Surface properties of coal and their role in coal beneficiation: Final report, 15:36705 (R;US)

California Univ., Davis, CA (USA)
Measurements of laser wavelength scaling ion acoustic decay instability and associated effects in laser-plasma interaction experiments: Final report, 15:38256 (R;US)

California Univ., Los Angeles, CA (USA)
Quantum transport in mesoscopic systems: Annual technical report, September 1989–September 1990, 15:37988 (R;US)

California Univ., Riverside, CA (USA). Inst. of Geophysics and Planetary Physics
[Sulfide-oxide-silicate phase equilibria and associated fluid inclusion properties in the Salton Sea geothermal system, California]: Final technical report, September 1, 1985–February 1, 1988, 15:36873 (R;US)

California Univ., San Diego, La Jolla, CA (USA). Dept. of Chemistry
UCSD geothermal chemistry program: Annual progress report, FY 1989, 15:36874 (R;US)

California Univ., San Diego, La Jolla, CA (USA). Dept. of Computer Science and Engineering
Controlled eager evaluation in a Dynamic-Arc Tagged-Token Dataflow Model, 15:38336 (R;US)

Carborundum Co., Niagara Falls, NY (USA). Structural Ceramics Div.
Synthesis of high purity sinterable silicon carbide powder: Final report, 15:37237 (R;US)

Case Western Reserve Univ., Cleveland, OH (USA). Case Center for Electrochemical Sciences
Electrode reaction mechanisms in molten carbonate fuel cells: Final report, 15:37044 (R;US)

CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete
Failure of Inconel X-750 bolts of internals of the CHOOZ-A nuclear power plant, 15:36910 (R;FR)
Heat transfer in reactor cavity during core-concrete interaction, 15:36909 (R;FR)
Objectives, specification and elaboration of technical scenarios for emergency drills involving a French PWR, 15:36908 (R;FR)
Performance assessment of alpha wastes disposal in deep geological formations, PACOMA project: granite option, 15:36768 (R;FR;In French)
Presentation of the ressac research program (rehabilitation of soils and surfaces after an accident), 15:36952 (R;FR)
Safety assessment for radiactive waste disposal, 15:36767 (R;FR;In French)
Scenarios used for the evaluations of the safety of a site for adioactive waste disposal in deep geologic formations, 15:36770 (R;FR;In French)
Sensitivity analysis concerning dose equivalents associated with the disposal of radioactive wastes in deep geological formations, 15:36769 (R;FR;In French)
Taking into account a reactivity accident in research reactors design, 15:36951 (R;FR;In French)
The nuclear safety in France, in 1988, 15:36988 (R;FR;In French)

CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)
Adaptation of magnesian cements to underground storage of nuclear wastes, 15:36779 (R;FR;In French)

CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale
Photo-oxidation and photo-reduction of the ruthenium complex tris (2,2'bipyridine) in an organic medium. Applications to photoelectrochemical cells and photoinduced redox catalysis, 15:36830 (R;FR;In French)

CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie
Synthesis and characterization of ruthenium fluorides and oxide fluorides with high oxidation states, 15:37347 (R;FR;In French)

CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Fondamentale (IRF)
Contribution on the study of light non methane hydrocarbons sources in the atmosphere, 15:37569 (R;FR;In French)

CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)
Software supervisor: extension to the on-line codes utilization in order to help the process control, 15:38314 (R;FR;In French)

CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Haute Energie
Electron accelerators and nuclear physics, 15:37426 (R;FR)
Inelastic events in nucleon-nucleon scattering experiments, 15:37890 (R;FR;In French)
The polarization observables and the short range deuteron structure, 15:37841 (R;FR;In French)

CEA Centre d'Etudes Scientifiques et Techniques d'Aquitaine, 33 - Le Barp (France)
Horizontal vibrations of piles in a centrifuge, 15:37398 (R;FR;In French)

Central Intelligence Agency, Washington, DC (USA)
Economic and Energy Indicators. Bi-weekly report, 15:37011 (R;US)
International Energy Statistical Review. Monthly report, 15:36732 (R;US)

Centre National de la Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matiernes Premieres (PRISEM)
A geochemical study of the fluids in several wells: The Momotombo geothermal field, 15:36865 (R;FR;In French)

Adaptation and experimentation of management and physical economy models to the problems of the regional energy planning, 15:37007 (R;FR;In French)
ARC: Chemical heat pumps, 15:37125 (R;FR;In French)
Follow-up of the regional energy conservation politics. Methods and illustration with the case of Charente-Poitou, 15:37006 (R;FR;In French)
Photovoltaic conversion through thin films organic semiconductors, 15:36834 (R;FR;In French)

Centre National de la Recherche Scientifique, 91 - Gif-sur-Yvette (France). Centre des Faibles Radioactivites
A geochemical study of the fluids in several wells: The Momotombo geothermal field, 15:36865 (R;FR;In French)

Centre Scientifique et Technique du Batiment, Etablissement de Nantes, 44 (France)
Wind heating feasibility, 15:36877 (R;FR;In French)

Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Reactor Physics
McSUB, a Monte Carlo Library for neutron transport in two different media for the neutron energy range 0.1-20 MeV, 15:37923 (R;SE)
Method of energy calibration of the TANSY neutron detectors, 15:37516 (R;SE)
One-speed neutron transport eigenvalues for reflected slabs and spheres, 15:37921 (R;SE)
Study of the multiple scattering effect in TEBENE using the Monte Carlo method, 15:37922 (R;SE)

China Nuclear Information Centre, Beijing, BJ (China)
Evaluation of radiation dose for radiological impact of airborne effluents of a coal-fired power plant, 15:37562 (R;CN;In Chinese)
Isolation and radioprotective assays of tissue inhibitory factors, 15:37664 (R;CN;In Chinese)
The irradiation effects on extraction properties and physical data of 30% TRPO-kerosene, 15:37367 (R;CN;In Chinese)
The photochemical behaviour of plutonium (IV), 15:37368 (R;CN;In Chinese)

Clarkson Univ., Potsdam, NY (USA). Dept. of Biology
Factors controlling decomposition in arctic tundra and related root mycorrhizal processes: [Progress report], 15:37635 (R;US)

Clarkson Univ., Potsdam, NY (USA). Fluid Mechanics, Heat and Mass Transfer Lab.
Theoretical studies on the role of transition in determining friction and heat transfer in smooth and rough passages: Final report, 15:37374 (R;US)

COE Corp., Mountain View, CA (USA)
Nondestructive evaluation research progress in 1989: Proceedings from the tenth annual EPRI NDE information meeting, 15:36934 (R;US)

Combustion Power Co., Inc., Menlo Park, CA (USA)
Performance analysis of a screenless (counter-current) Granular Bed Filter on a subpilot-scale PFBC [pressurized fluidized-bed combustor], Volume 1: Final report, 15:36889 (R;US)

Congressional Budget Office, Washington, DC (USA)
Risks and benefits of building the superconducting super collider. Special study, 15:37442 (R;US)

D

Dartmouth Coll., Hanover, NH (USA)
Nonlinear magneto-hydrodynamics: Progress report, January 1, 1989–June 30, 1990, 15:38021 (R;US)

Delaware Univ., Newark, DE (USA). Dept. of Physics and Astronomy
Accurate alpha sticking fractions from improved calculations relevant for muon catalyzed fusion: Final report, 15:37709 (R;US)

Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office
Groundwater Protection Management Program, 15:37614 (R;US)

Department of Energy, London (UK)
Energy efficiency demonstration scheme: June 1988 review of ETSU portfolio, 15:37047 (R;GB)

Department of Energy, London (UK). Energy Efficiency Office
The development of an expert system for heat exchanger selection, 15:37152 (R;GB)

Department of the Navy, Washington, DC (USA)
Laser-diode-pumped, erbium-doped, solid-state laser with high slope efficiency, 15:37425 (P;US)

Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)
Solar energy and hydrogen - for qualitative growth, 15:37005 (R;DE;In German)

Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Stuttgart (Germany, F.R.). Inst. fuer Technische Thermodynamik
Research and development program on solar thermal use in the high temperature range, 15:36845 (R;DE;In German)

Deutsche Shell AG, Hamburg (Germany, F.R.). PAE-Lab.
Analytical methods for metals in petroleum and related products, 15:36737 (R;DE;In German)

Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.)
Analytical methods for metals in petroleum and related products, 15:36737 (R;DE;In German)
Application of the absorption of seismic waves in hydrocarbon exploration, 15:36719 (R;DE)
Short path molecular distillation and extraction with gases in the supercritical state for improved characterization of petroleum residues, 15:36736 (R;DE;In German)

Deutscher Wetterdienst, Muenchen (Germany, F.R.)
MAB-project 6 'Research for the ecological system Berchtesgaden': Climatological measurements at the Alpine National Park, wind systems and inversions. Disciplinary report FB 07 climatology, 15:37585 (R;DE;In German)

Duke Univ. Medical Center, Durham, NC (USA). Dept. of Radiology
SPECT [single photon emission computed tomography] assay of radiolabeled monoclonal antibodies: Progress report, September 1989–April 1990, 15:37645 (R;US)

E

Ecole Nationale Superieure des Mines, 75 - Paris (France)
Adaptation of magnesian cements to underground storage of nuclear wastes, 15:36779 (R;FR;In French)
Heat pump and heliogeothermal space heating Aulnay-sous-Bois. The 1985 season, 15:36872 (R;FR;In French)

Ecole Nationale Superieure du Petrole et des Moteurs (ENSPM), 92 - Rueil-Malmaison (France)
Propagation in an adsorbing porous medium of a mixture of anionic and non-ionic surfactants, 15:36725 (R;FR;In French)
Synthesis of organolanthanides by metal addition on insaturated substrates in ether and reactivity, 15:37348 (R;FR;In French)

Ecole Polytechnique, 91 - Palaiseau (France)
Applied mathematics, 15:37990 (R;FR;In French)
Applied optics, 15:37186 (R;FR;In French)
Data processing, 15:38318 (R;FR;In French)
Econometrics, 15:37010 (R;FR;In French)
Fine chemistry, 15:37343 (R;FR;In French)
High energy nuclear physics, 15:37751 (R;FR;In French)
Interfaces and thin films physics, 15:37285 (R;FR;In French)
Management research, 15:38309 (R;FR;In French)
Mathematics, 15:37991 (R;FR;In French)
Organic synthesis, 15:37346 (R;FR;In French)
Quantum chemistry and scientific calculus, 15:37342 (R;FR;In French)
Quantum optics, 15:37187 (R;FR;In French)
Reaction mechanisms, 15:37344 (R;FR;In French)
Solid state mechanics, 15:37162 (R;FR;In French)
Studies on the irradiated solids, 15:37369 (R;FR;In French)
The condensed matter physics, 15:37188 (R;FR;In French)
The direction of the laboratories, 15:38342 (R;FR;In French)
The phosphorus and the transition metals chemistry, 15:37345 (R;FR;In French)
The physics of the ionized media, 15:38025 (R;FR;In French)
The utilization of high-intensity lasers, 15:37403 (R;FR;In French)
Theoretical physics, 15:37989 (R;FR;In French)

Edison Welding Inst., Columbus, OH (USA)
Criteria for hot tap welding further studies: Final report: Volume 2, 15:36752 (R;US)
Review of procedures for welding onto pressurized pipelines: Final report: Volume 1, 15:36751 (R;US)

EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations
Improved yield of high resolution mercuric iodide gamma-ray spectrometers, 15:37517 (R;US)

EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations
Curve fitting and error modeling for the digitization process near the Nyquist rate, 15:37402 (R;US)
[Workshop on artificially ionized layers in the atmosphere]: Foreign trip report, October 5–14, 1989, 15:37568 (R;US)

EG and G Idaho, Inc., Idaho Falls, ID (USA)
A Recoil Mass Spectrometer for the HHIRF [Holifield Heavy Ion Research Facility] facility, 15:37518 (R;US)
Advanced binary geothermal power plants: Limits of performance, 15:36868 (R;US)
Alarm Processing System, 15:36969 (R;US)
An account of the OECD LOFT [Organization for Economic Cooperation and Development Loss-of-Fluid] Project, 15:36983 (R;US)
An account of the OECD LOFT [Organization for Economic Cooperation and Development Loss of Fluid Test] Project: Executive summary, 15:36984 (R;US)
Bioprocessing of fossil fuels program: Summary of advanced research and technology development sponsored activities for the period October 1, 1989–December 31, 1989, 15:36701 (R;US)
Center for Bioprocessing Technology and Biotechnology, 15:36700 (R;US)
Chlorinated hydrocarbon substitution program, 15:37283 (R;US)
Combustion testing and thermal modeling of proposed CIT [Compact Ignition Tokamak] graphite tile materials, 15:38257 (R;US)
Engineering evaluation testing of the Soleq Dual Battery Van, 15:37157 (R;US)
Extensions to SCDAP/RELAP5/MOD2 debris analysis models for the severe accident analysis of Savannah River Site (SRS) reactors preliminary design report, 15:36967 (R;US)
Field experience in using laser acoustic sensing for inspection, 15:37394 (R;US)
Integrated Reliability and Risk Analysis System (IRRAS) Version 2.0 user's guide, 15:36980 (R;US)
Internal dosimetry and control, 15:37667 (R;US)
Laser ultrasonic measurements on ceramic materials with rough surfaces, 15:37232 (R;US)
MAAP [Modular Accident Analysis Program] steam generator modeling and benchmarking with Westinghouse MB-2 tests, 15:36968 (R;US)
Membrane process designs in the recovery of bio-fuels and biochemicals, 15:37150 (R;US)
Membrane technology applications in the food industry: Present and future, 15:37151 (R;US)
Multimegawatt space power reactors, 15:36925 (R;US)
NDE [nondestructive evaluation] of critical currents in high T_c superconductors, 15:37233 (R;US)
Parametric design studies of toroidal magnetic energy storage units, 15:38258 (R;US)
Phenomenology, diagnostics, and non-LTE effects in plasma-particle interactions, 15:37332 (R;US)
Postirradiation examination results from the LP-FP-2 center fuel module, 15:36970 (R;US)
Power Burst Facility/Boron Neutron Capture Therapy Program for Cancer Treatment: Monthly bulletin, Volume 4, No. 2, 15:37666 (R;US)
Prevention of early containment failure due to high pressure melt ejection and direct containment heating for advanced light water reactors: Advanced Reactor Severe Accident Program, 15:36965 (R;US)
Reactivity studies on the final preconceptual reference design of the Advanced Neutron Source, 15:36950 (R;US)
Real-time monitoring of ceramic sintering with laser ultrasonics, 15:37231 (R;US)
Redesign of the PREPP [Process Experimental Pilot Plant] feed, ash discharge and sludge handling systems, 15:36778 (R;US)
Simulation of Phases 3 and 4 of the TMI-2 accident using MAAP-DOE and MAAP 3.0B, Task 3.9, 15:36964 (R;US)
Technical support for the EPRI [Electric Power Research Institute] debris coolability requirement for advanced light water reactors: Advanced Reactor Severe Accident Program, 15:36904 (R;US)
The geopressured-geothermal resource: Transition to commercialization, 15:36866 (R;US)
The LP-FP-2 severe fuel damage scenario and discussion of the relative influence of the transient and reflood phases in affecting the final condition of the bundle, 15:36971 (R;US)
Transporting spent and damaged fuel in the United States: Recent experience and lessons learned related to the evolving transportation policy of the US Department of Energy, 15:36760 (R;US)
Vitreous joining of SiC fiber reinforced SiC composites, 15:37284 (R;US)

Electric Power Research Inst., Palo Alto, CA (USA)
Detection and control of microbiologically influenced corrosion: An extension of the sourcebook for microbiologically influenced corrosion in nuclear power plants, 15:36935 (R;US)
Direct embedment foundation research: Load test summaries: Final report, 15:36998 (R;US)
Nondestructive evaluation research progress in 1989: Proceedings from the tenth annual EPRI NDE information meeting, 15:36934 (R;US)

Energetics, Inc., Columbia, MD (USA)
The effects of land disposal restrictions for certain hazardous-waste contaminated soil and debris on energy-related industries: Final report, 15:37149 (R;US)

Energy and Environmental Research Corp., Irvine, CA (USA)
An investigation to define the physical/chemical constraints which limit NO_x emission reduction achievable by reburning: Final report, 15:36708 (R;US)

Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards
Progress in the prevention and control of air pollution in 1988: Report to congress. Annual report, 15:37572 (R;US)

Exeter Univ. (UK). Energy Study Unit
An approach to the design of energy efficient heated buildings, 15:37129 (R;GB)

F

Factory Mutual Research Corp., Norwood, MA (USA)
Fire protection review revisit No. 2, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio, 15:36799 (R;US)

Fauske and Associates, Inc., Burr Ridge, IL (USA)
Technical support for the EPRI [Electric Power Research Institute] debris coolability requirement for advanced light water reactors: Advanced Reactor Severe Accident Program, 15:36904 (R;US)

Fermi National Accelerator Lab., Batavia, IL (USA)
A new limit on the mass of the top quark, 15:37758 (R;US)
Ampacity test of 28 AWG ribbon cables, 15:37404 (R;US)
Coherent instability limitations of Fermilab's upgrades, 15:37455 (R;US)
Dilepton and dihadron production in proton-nucleus collisions at 800 GeV, 15:37759 (R;US)
Inclusive jet cross section at $\sqrt{s}$ = 1.8 TeV, 15:37757 (R;US)
Investigation of the mechanical properties of superconducting coils, 15:37405 (R;US)
Large P_t jets at CDF, 15:37756 (R;US)
Recent developments in high-speed, non-sampling electromagnetic calorimetry, 15:37519 (R;US)
Recent results on direct photons from CDF [Collider Detector at Fermilab], 15:37760 (R;US)
SDC at high luminosity, 15:37520 (R;US)
The dijet invariant mass at the Tevatron Collider, 15:37755 (R;US)
Transition crossing with the space charge: The Johnsen and Umstaetter effects, 15:37456 (R;US)

Fish and Wildlife Service, Washington, DC (USA)
Hydric hammocks: A guide to management, 15:37594 (R;US)

Fisk Univ., Nashville, TN (USA). Dept. of Biology
Microbial liquefaction of peat for the production of synthetic fuels: Final progress report, 15:36694 (R;US)
Florida Museum of Natural History, Gainesville, FL (USA)
Hydric hammocks: A guide to management, 15:37594 (R;US)
Florida State Univ., Tallahassee, FL (USA). Dept. of Physics
Flue gas cleanup technology utilizing energetic electrons: Final report, May 6, 1986–March 5, 1989, 15:36899 (R;US)
Food and Agriculture Organization of the United Nations, Rome (Italy)
Factors affecting practical application of food irradiation: Proceedings of an advisory group meeting held in Vienna, 27 June - 1 July 1988, 15:37659 (R;XA)
Forschungszentrum Juelich GmbH (Germany, F.R.). Programmgruppe Technik und Gesellschaft
'Chernobyl' in the public opinion of the Federal Republic of Germany - risk perception, political attitudes and information, 15:37025 (R;DE;In German)
Fossil Energy Research Corp., Laguna Hills, CA (USA)
Simultaneous NO_x/SO_2 removal by the dry injection of lime-urea hydrate: Final report, 15:36897 (R;US)
Foster Wheeler Development Corp., Livingston, NJ (USA)
Second-generation pressurized fluidized bed [PFB] combustion plant: Conceptual design and optimization of a second-generation PFB combustion plant, Phase 1, Task 1: Volume 1, 15:36888 (R;US)

G

GAI Consultants, Inc., Monroeville, PA (USA)
Direct embedment foundation research: Load test summaries: Final report, 15:36998 (R;US)
General Atomics, San Diego, CA (USA)
Research operations on reversed field pinch: Final report, February 12, 1986–January 31, 1988, 15:38259 (R;US)
Geological Survey, Denver, CO (USA)
Stratigraphic correlation and petrography of the bedded tuffs, Yucca Mountain, Nye County, Nevada, 15:37690 (R;US)
Geological Survey, Reston, VA (USA)
Physical and chemical characteristics of topographically affected airflow in an open borehole at Yucca Mountain, Nevada, 15:36771 (R;US)
Georgia Inst. of Tech., Atlanta, GA (USA). School of Chemical Engineering
Supercritical fluid thermodynamics for coal processing: Quarterly progress report, January 1, 1990–March 31, 1990, 15:36695 (R;US)
Gesellschaft fuer Reaktorsicherheit mbH (GRS), Koeln (Germany, F.R.)
Application of the finite-element program NAMMU for a model of a radioactive waste repository site, 15:36765 (R;DE;In German)
GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.)
TEM investigations of the neutron irradiation behaviour of boron carbides, 15:37234 (R;DE;In German)
Transport processes of suspended matter derived from time series in a tidal estuary, 15:37597 (R;DE)
Goettingen Univ. (Germany, F.R.). Inst. fuer Bodenkunde und Waldernaehrung
Influence of reductions in deposition on the degree of acidification of soils and groundwater in forests - assessment of critical loads from the atmosphere. Final report, 15:37622 (R;DE;In German)
Grenoble-1 Univ., 38 (France)
Photo-oxidation and photo-reduction of the ruthenium complex tris (2,2'bipyridine) in an organic medium. Applications to photoelectrochemical cells and photoinduced redox catalysis, 15:36830 (R;FR;In French)
Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires
Influence of neutron and proton alignments on the shape of A = 120-130 transitional nuclei, 15:37870 (R;FR)
Influence of the mass asymmetry of the entrance channel on incomplete fusion processes, 15:37894 (R;FR)
Neutron-Antineutron oscillations in nuclei, 15:37787 (R;FR)

H

Hamburg Univ. (Germany, F.R.). Fachbereich Geowissenschaften
TEM investigations of the neutron irradiation behaviour of boron carbides, 15:37234 (R;DE;In German)
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Landeskultur und Pflanzenoekologie
Changes in terrestrial ecosystems after long-term exposure to airborne pollutants - studies on the effects of ozone and NO_x immissions on spontaneous vegetation. Final report, 15:37681 (R;DE;In German)

I

Illinois Inst. of Tech., Chicago, IL (USA). Dept. of Chemical Engineering
Electrode reaction mechanisms in molten carbonate fuel cells: Final report, 15:37044 (R;US)
Predictive models for circulating fluidized bed combustors: Three dimensional code: Second technical progress report, 15:36713 (R;US)
Inhalation Toxicology Research Inst., Albuquerque, NM (USA)
Biological characterization of radiation exposure and dose estimates for inhaled uranium milling effluents: Final report, 15:36803 (R;US)
Institut fuer Erdoelforschung, Clausthal-Zellerfeld (Germany, F.R.)
Short path molecular distillation and extraction with gases in the supercritical state for improved characterization of petroleum residues, 15:36736 (R;DE;In German)
Institut National des Sciences Appliquees (INSA), 69 - Villeurbanne (France)
Study and realization by liquid phase epitaxy of $Ga_{1-y}Al_yAs$ photocells, 15:36831 (R;FR;In French)
Institut National Polytechnique, 54 - Nancy (France)
Pyrolysis-gasification of biomass. Development of a fluidized bed reactor, 15:36822 (R;FR;In French)
Institute of Gas Technology, Chicago, IL (USA)
Experimental and theoretical investigation of the formation and growth of ash agglomerates: Final report, 15:36693 (R;US)
Instituto de Asuntos Nucleares, Bogota (Colombia)
Progress report 1984, 15:38310 (R;CO;In Spanish)
Progress report 1987, 15:38311 (R;CO;In Spanish)
Progress report 1988, 15:38312 (R;CO;In Spanish)
Institutt for Energiteknikk, Kjeller (Norway)
Review of the chronic exposure pathways models in MACCS [MELCOR Accident Consequence Code System] and several other well-known probabilistic risk assessment models, 15:37599 (R;US)
International Atomic Energy Agency, Vienna (Austria)
Factors affecting practical application of food irradiation: Proceedings of an advisory group meeting held in Vienna, 27 June - 1 July 1988, 15:37659 (R;XA)
Handling, conditioning and disposal of spent sealed sources: Technical manual for the management of low and intermediate level wastes generated at small nuclear research centres and by radioisotope users in medicine, research and industry, 15:37937 (R;XA)
International Commission on Radiation Units and Measurements, Bethesda, MD (USA)
Clinical neutron dosimetry: Part 1, Determination of absorbed dose in a patient treated by external beams of fast neutrons, 15:37938 (R;US)

J

Japan Atomic Energy Research Inst., Tokyo (Japan)
Electron temperature profile measurement using the filter absorption method in JT-60, 15:38029 (R;JP)

Proceedings of the international symposium on radiation vulcanization of natural rubber latex, 15:36817 (R;JP)
Test on fast data transfer between a VME-bus system and a CAMAC system, 15:38030 (R;JP;In Japanese)

Johnson (E.R.) Associates, Inc., Oakton, VA (USA)
Classification of spent nuclear fuel (SNF), 15:36762 (R;US)

Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems
Neutral strange particle production in antiproton-nucleus annihilation at low energies, 15:37895 (R;SU)

K

Kentucky Univ., Lexington, KY (USA). Dept. of Microbiology and Immunology
The role of purine degradation in methane biosynthesis and energy production in Methanococcus vannielii: Progress report, March 1, 1989–February 28, 1990, 15:37634 (R;US)

Kernforschungsanlage Juelich GmbH (Germany, F.R.). Programmgruppe Technik und Gesellschaft
Game theoretical analysis of safeguards effectiveness. Pt. 3. Equilibrium solutions, 15:36810 (R;DE)

Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Medizinische Abt.
Preclinical diagnosis and emergency medical care in case of radiation accidents, 15:36972 (R;DE;In German)

Kiel Univ. (Germany, F.R.). Inst. fuer Geophysik
Application of the absorption of seismic waves in hydrocarbon exploration, 15:36719 (R;DE)

Knolls Atomic Power Lab., Schenectady, NY (USA)
Copper(II) oxide solubility behavior in aqueous sodium phosphate solutions at elevated temperatures, 15:37236 (R;US)

Ktech Corp., Albuquerque, NM (USA)
STL [Simulation Technology Laboratory] Global Control System, technical reference, 15:37499 (R;US)

L

Lawrence Berkeley Lab., CA (USA)
Computer modeling of the chemistry of aqueous scrubber systems, 15:36900 (R;US)
Magnetic field dependence of the specific heat of heavy-fermion $YbCu_{4.5}$, 15:37288 (R;US)
Maintaining optimum light output with a thermally conductive heat pipe, 15:37120 (R;US)
Pressure dependence of the specific heat of heavy-fermion $YbCu_{4.5}$, 15:37979 (R;US)
Specific heat of $La_{2-x}Sr_xCuO_4$: Volume fraction of superconductivity; possible structural transition at 45K, 15:37980 (R;US)

Lawrence Berkeley Lab., CA (USA). SSC Central Design Group
Radiation levels in SSC [Superconducting Super Collider] calorimetry, 15:37535 (R;US)

Lawrence Livermore National Lab., CA (USA)
1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion: Proceedings, 15:37138 (R;US)
A compact x-ray free electron laser, 15:37447 (R;US)
A fast injection system with a superconducting accumulator ring for a tau charm factory, 15:37502 (R;US)
A scalable coherent cache system with fuzzy directory state, 15:38337 (R;US)
A scalable coherent cache system with incomplete directory state, 15:38339 (R;US)
A site for the astrophysical gamma-ray process, 15:37696 (R;US)
Accelerator mass spectrometry in the biomedical sciences: Applications in low-exposure biomedical and environmental dosimetry, 15:37653 (R;US)
Computer animation in mathematics, science and art, 15:38340 (R;US)
Conceptualization of TREE: A model of the effects of acid precipitation and air pollutants on the growth of trees: Progress report, 15:37586 (R;US)
Controlled eager evaluation in a Dynamic-Arc Tagged-Token Dataflow Model, 15:38336 (R;US)
Densification studies of refractory materials using Hot Isostatic Pressing (HIP) and tantalum containment, 15:37243 (R;US)
Depth buffer shadow algorithms, 15:38338 (R;US)
Design and fabrication of high damage threshold turning mirrors for the Nova laser, 15:37244 (R;US)
Design of thick aperture for fine-resolution neutron penumbral imaging, 15:38271 (R;US)
Development of a drug assay using surface-enhanced Raman spectroscopy, 15:37298 (R;US)
Equal eigenvalues in multicomponent diffusion: The extraction of diffusion coefficients from experimental data in ternary systems, 15:37955 (R;US)
Forecast of criticality experiments needed to support US DOE contractor operations, 1987–1992, 15:36800 (R;US)
Gated microchannel plate detector (Engineering Materials), 15:37512 (E;US)
Generic initiation train for the fuzing: Revision 1, 15:37553 (R;US)
Incorporation of an explosive cloud rise code into ARAC's [Atmospheric Release Advisory Capability] ADPIC transport and diffusion model, 15:37588 (R;US)
Large area laser conditioning of dielectric thin film mirrors, 15:38273 (R;US)
Laser conditioning of optical thin films, 15:38272 (R;US)
Level spin and moments of inertia in superdeformed nuclei near A = 194, 15:37882 (R;US)
Material characteristics related to the fracture and particulation of electrodeposited-copper shaped charge jets, 15:37198 (R;US)
Models and theory for precompound angular distributions, 15:37909 (R;US)
MODIX active detector (drawings AAA88-1104683-OA) [Engineering materials], 15:37513 (E;US)
MTX [Microwave Tokamak Experiment] data acquisition and analysis computer network: Revision 1, 15:38053 (R;US)
MTX [Microwave Tokamak Experiment] diagnostics and timing system for FEL [free electron laser] heating experiments: Revision 1, 15:38276 (R;US)
Physics study of the application of an IFEL [Induction Free-Electron Laser] to CIT [Compact Ignition Tokamak]: Interim report, 15:38275 (R;US)
Pixar data visualization tools overview, 15:38335 (R;US)
Radio loud far-infrared galaxies, 15:37695 (R;US)
Relativistic klystron research for linear colliders, 15:37501 (R;US)
Review of the state of criticality of the Three Mile Island Unit 2 core and reactor vessel, 15:36966 (R;US)
Species-diffusion phenomena in glass: A one-dimensional, transient model, 15:37297 (R;US)
Start-effect measurement of high FEL [free-electron laser] electric fields in MTX [Microwave Tokamak Experiment] by laser-aided particle-probe spectroscopy, 15:38052 (R;US)
Stimulated Raman scattering in optical fibers: Polychromatic single-field numerical experiments, 15:37954 (R;US)
Theoretical simulations of the synchrotron instability in high gain, high power free electron lasers: Final report, 15:37460 (R;US)
Toward more realistic material models for release and dispersion of heavy gases, 15:37587 (R;US)
Transactions of the criticality alarm systems workshop, 15:36801 (R;US)
Uncertainty in exposure and health-risk assessment: An integrated approach, 15:37623 (R;US)
VJACS detector assembly (HyJacs active detector), drawings AAA87-107748-OA [Engineering materials], 15:37514 (E;US)

Lehigh Univ., Bethlehem, PA (USA)
Mechanisms and controlling characteristics of the catalytic oxidation of methane: Final technical report, June 15, 1986–June 14, 1990, 15:37341 (R;US)

Linkoeping Univ. (Sweden). Dept. of Mathematics
Scattering theory for self-adjoint extensions, 15:37993 (R;SE)

Los Alamos National Lab., NM (USA)
A CLIPS expert system for clinical flow cytometry data analysis, 15:37640 (R;US)
A lattice gas model for thermohydrodynamics, 15:37740 (R;US)
A search for $\mu \rightarrow e\gamma$ at the level of 10^{-13}, 15:37773 (R;US)

Distance learning conference proceedings, 15:38343 (R;US)
EXPAC [EXPlosion Analysis Code] user's manual: A computer code for analyzing explosion-induced flow and material transport in nuclear facilities, 15:36802 (R;US)
Experiments on superconductor imaging surface magnetometry, 15:37406 (R;US)
High explosives skid impact initiation study, 15:37550 (R;US)
Hydrogeochemical investigations in support of well logging operations at the Zunil geothermal field, Guatemala, 15:36862 (R;US)
Important experiments to test for longer-ranged new gravitational forces, 15:37992 (R;US)
It's not hype, it's communication: Using public relations techniques to improve your technical messages, 15:38344 (R;US)
Lectures from the workshop on nucleon-nucleon bremsstrahlung, January 25–26, 1990, 15:37763 (R;US)
Life Sciences Division and Center for Human Genome Studies Annual report 1989, 15:37637 (R;US)
Long-term fate of depleted uranium at Aberdeen and Yuma Proving Grounds: Final report, Phase 1: Geochemical transport and modeling, 15:36795 (R;US)
Los Alamos climatology, 15:37570 (R;US)
Low-mass, high-rate cylindrical MWPC's for the MEGA experiment, 15:37526 (R;US)
Modeling the hydraulic characteristics of the Fenton Hill, New Mexico Hot Dry Rock reservoir, 15:36860 (R;US)
Nonlinear elastic wave interactions in rock, 15:37287 (R;US)
OMNI development of an engineering product data management system, 15:38320 (R;US)
Principles of superconductor imaging surface gradiometry, 15:37978 (R;US)
Progress in hot dry rock technology development, 15:36870 (R;US)
Results of investigations at the Ahuachapan geothermal field, El Salvador: Part 1, Well logging and brine geochemistry, 15:36861 (R;US)
Sampling plans to find faulty waste storage drums, 15:37377 (R;US)
Spectral transport model for turbulence, 15:37739 (R;US)
Tecuamburro Volcano, Guatemala geothermal gradient core hole drilling, operations, and preliminary results, 15:36863 (R;US)
Texture of materials by time-of-flight neutron diffraction, 15:37191 (R;US)
The AFDM [advanced fluid dynamics model] program: Scope and significance, 15:36926 (R;US)
The effects of exchange gas temperature and pressure on the beta-layering process in solid deuterium-tritium fusion fuel, 15:38260 (R;US)
The "Art" of in situ fluid sampling and the remarkable compositional variations in the wellbore fluid of VC-2B, Valles Caldera, New Mexico, 15:36864 (R;US)
Two-dimensional multiburst calculations with the SHALE code, 15:37551 (R;US)

Louisiana State Univ., Baton Rouge, LA (USA). Dept. of Petroleum Engineering
Cyclic CO_2 injection for light oil recovery: Performance of a cost shared field test in Louisiana: [Sixth quarterly report], April–June 1990, 15:36724 (R;US)

Louisiana State Univ., Baton Rouge, LA (USA). School of Geoscience
Environmental monitoring at designed geopressured-geothermal well sites, Louisiana and Texas: Quarterly status report, April–June 1990, 15:36867 (R;US)

Louisville Univ., KY (USA). Dept. of Chemical Engineering
Mechanism of hydrodenitrogenation: Part 1, Preparation and characterization of acidic supports, 15:36696 (R;US)

Lund Univ. (Sweden). Dept. of Nuclear Physics
Development of a scanning proton microprobe - computer-control, elemental mapping and applications, 15:37333 (R;SE)

Lund Univ. (Sweden). Dept. of Oncology
Management and prognosis of patients with high-grade soft tissue sarcomas: An evaluation of a Scandinavian joint care program, 15:37648 (R;SE)

M

Maine Univ., Orono, ME (USA)
Research on droplet formation for application to kraft black liquors—Final project report: Technical report No. 5, 15:37146 (R;US)

Maryland Univ., College Park, MD (USA). Lab. for Plasma Research
Joint proposal for US/USSR on nonlinear dynamics and plasma transport: Progress report, September 1989–September 14, 1990, 15:38024 (R;US)

Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik
X-ray observations of gamma-ray burst sources, 15:37692 (R;DE)

Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik
Production and decay of the τ lepton, 15:37777 (R;DE;In German)

Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)
Generalized Cherry oscillators and negative energy waves, 15:38027 (R;DE)
On the roles of the density and temperature gradients in the theory of nonlinear drift waves, 15:38028 (R;DE)
Self-similar statistics in MHD turbulence, 15:38026 (R;DE)

Mechanical Technology, Inc., Latham, NY (USA)
A magnetically coupled Stirling engine driven heat pump: Design optimization and operating cost analysis, 15:37143 (R;US)

Michigan State Univ., East Lansing, MI (USA)
DOE/University instrumentation program grant for funding of the high field, high mass, double focusing, high resolution mass spectrometer: Final report, 15:37331 (R;US)

Microalloying International, Inc. (USA)
Pulsed-gas-metal-arc welding (PGMAW) of API 5LX-80 pipe: Final report, 15:37194 (R;US)

Midwest Research Inst., Kansas City, MO (USA)
Immunological and biochemical effects of 60-Hz electric and magnetic fields in humans: Phase 3: Quarterly report No. 6, January 1–March 31, 1987, 15:37683 (R;US)
Immunological and biochemical effects of 60-Hz electric and magnetic fields in humans: Phase 3, Quarterly report No. 9, October 1–December 31, 1987, 15:37684 (R;US)

Mississippi State Univ., Mississippi State, MS (USA)
Compendium of MHD-related terminology, 15:37039 (R;US)

Missouri Univ., Columbia, MO (USA). Dept. of Biochemistry
Genetics and molecular biology of hydrogen metabolism in sulfate reducing bacteria: Progress report, May 1, 1987–December 1, 1989, 15:36819 (R;US)

Monitored Retrievable Storage Review Commission, Washington, DC (USA)
Nuclear waste: Is there a need for federal interim storage, 15:36783 (R;US)

MSE, Inc., Butte, MT (USA)
Compendium of MHD-related terminology, 15:37039 (R;US)

Muenchen Univ. (Germany, F.R.). Meteorologisches Inst.
Modelling of the transport of air pollution in orographic regions like Northeast Bavaria, 15:37584 (R;DE;In German)

N

Nagoya Univ. (Japan). Plasma Science Center
Electron motion in a nonlinear magnetosonic wave propagating perpendicularly to a magnetic field, 15:38037 (R;JP)
New non-axisymmetric eigenmodes associated with an edge plasma layer, 15:38038 (R;JP)

National Accelerator Centre, Faure (South Africa)
A national photon dosimetry intercomparison, 15:37529 (R;ZA)
Annual report June 1988, 15:37428 (R;ZA)
Annual report June 1989, 15:37429 (R;ZA)

National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center
Assessment of fundamental materials needs for thick thermal barrier coatings (TTBC's) for truck diesel engines, 15:37230 (R;US)

National Geophysical Data Center, Boulder, CO (USA)
Solar-Geophysical Data Number 546, February 1990. Part 1 (prompt reports). data for January 1990, December 1989, and late data, 15:37693 (R;US)
Solar-Geophysical Data Number 546, February 1990. Part 2 (comprehensive reports). Data for August 1989 and miscellaneous, 15:37694 (R;US)

National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)
National Institute for Petroleum and Energy Research monthly progress report for May 1990, 15:36726 (R;US)

National Inst. of Radiological Sciences, Chiba (Japan)
Radioactivity survey data in Japan, part 2: Dietary materials, 15:37660 (R;JP)
Radioactivity survey data in Japan, part 1: Environmental materials, 15:37598 (R;JP)
Radioactivity survey data in Japan, part 2: Dietary materials, 15:37661 (R;JP)

National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)
Performance of BL10B and a simple performance test for EXAFS stations, 15:37488 (R;JP)
Plans for production of undulator X-rays on AR and its applications to material and biological sciences, 15:37944 (R;JP;In Japanese)
Proceedings of the second workshop of Japan-UK collaboration on neutron scattering research, 15:37945 (R;JP)
Proceedings of the workshop 'topology, field theory and superstrings', 15:37806 (R;JP)

National Museum of Natural History, Washington, DC (USA)
Smithsonian Institution: Bulletin of the Global Volcanism Network. Monthly report, 15:37689 (R;US)

National Technical Information Service, Springfield, VA (USA)
Air-pollution tracer studies in the lower atmosphere. May 1985-March 1990 (A Bibliography from the NTIS data base). Report for May 1985-March 1990, 15:37578 (R;US)
Radium contamination in the environment. January 1972-July 1989 (A Bibliography from Pollution Abstracts). Report for January 1972-July 1989, 15:37620 (R;US)
Tribology: Coatings. October 1976-March 1990 (A Bibliography from the COMPENDEX data base). Report for October 1976-March 1990, 15:37153 (R;US)

National Wetlands Research Center, Slidell, LA (USA)
Hydric hammocks: A guide to management, 15:37594 (R;US)

NEI International Research and Development Co. Ltd., Newcastle-on-Tyne (UK)
The development of an expert system for heat exchanger selection, 15:37152 (R;GB)

Nevada Univ., Las Vegas, NV (USA). Water Resources Center
Off-Site Radiation Exposure Review Project: Phase 2 soils program: Revision, 15:37596 (R;US)

Nevada Univ., Reno, NV (USA). Water Resources Center
NTS [Nevada Test Site] Mesa recharge study FY 1988: Letter report, 15:37615 (R;US)

New Mexico State Univ., Las Cruces, NM (USA). Southwest Technology Development Inst.
SouthWest Region Experiment Station (SWRES) 1989 report, 15:36843 (R;US)

New York Univ., NY (USA). Magneto-Fluid Dynamics Div.
Plasma properties: Annual report, January 1, 1989–December 31, 1989, 15:38023 (R;US)

Niels Bohr Inst., Copenhagen (Denmark)
Baryons and ladders, 15:37788 (R;DK)
Duality and modular invariance in rational conformal field theories, 15:37811 (R;DK)
The β-function in 4-dimensional topological Yang-Mills theory, 15:37810 (R;DK)
The bosonic string represented as ϕ^3 graphs: New Monte Carlo simulations, 15:37809 (R;DK)

Northeastern Univ., Boston, MA (USA)
Topics in gauge theories and the unification of elementary particle interactions: Progress report, March 1, 1990–February 28, 1990, 15:37754 (R;US)

Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I
NRC TLD [thermoluminescent dosimeter] Direct Radiation Monitoring Network: Progress report, January–March 1990: Volume 10, No. 1, 15:36973 (R;US)

Nuclear Regulatory Commission, Washington, DC (USA)
Loss of vital ac power and the residual heat removal system during mid-loop operations at Vogtle Unit 1 on March 20, 1990, 15:36975 (R;US)

Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering
Environmentally assisted cracking in light water reactors: Semiannual report, October 1988–March 1989: Volume 8, 15:36906 (R;US)
PR-EDB: Power Reactor Embrittlement Data Base, version 1: Program description, 15:36907 (R;US)

Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology
Action plans for motor-operated valves and check valves, 15:36974 (R;US)

Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services
Title list of documents made publicly available, February 1–28, 1990: Volume 12, No. 2, 15:36933 (R;US)

Nuclear Regulatory Commission, Washington, DC (USA). Div. of Operational Assessment
Closeout of IE Bulletin 84-03: Refueling cavity water seal: Final report, 15:36979 (R;US)

Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications
Biological characterization of radiation exposure and dose estimates for inhaled uranium milling effluents: Final report, 15:36803 (R;US)

Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution
Regulatory analysis for the resolution of generic issue C—8, main steam isolation valve leakage and LCS [leakage control system] failure, 15:36905 (R;US)

Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research
Data summary report for fission product release test VI-3, 15:36944 (R;US)
Human factors issues associated with advanced instrumentation and controls technologies in nuclear plants, 15:36939 (R;US)
Integrated Reliability and Risk Analysis System (IRRAS) Version 2.0 user's guide, 15:36980 (R;US)
Review of the chronic exposure pathways models in MACCS [MELCOR Accident Consequence Code System] and several other well-known probabilistic risk assessment models, 15:37599 (R;US)

Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research
TRAC-PF1 MOD1 post test calculations of the OECD LOFT Experiment LP-SB-1, 15:36981 (R;US)
TRAC-PF1/MOD1 post-test calculations of the OECD LOFT Experiment LP-SB-3, 15:36982 (R;US)

O

Oak Ridge Associated Universities, Inc., TN (USA)
Mechanical properties of coatings and interfaces, 15:37225 (R;US)
Mechanical properties of silica coatings, 15:37226 (R;US)

Oak Ridge Gaseous Diffusion Plant, TN (USA)
Historical validation of an attrition model, 15:37546 (R;US)
Safeguards training course: Nuclear material safeguards for enrichment plants: Part 3, Uranium enrichment plant: Description, material control and accountability procedures, and safeguards, 15:36811 (R;US)
Safeguards training course: Nuclear material safeguards for enrichment plants: Part 4, Gas centrifuge enrichment plant: Diversion scenarios and safeguards activities, 15:36812 (R;US)
Selected properties of c-perfluorobutane, 15:37286 (R;US)

Oak Ridge National Lab., TN (USA)

A decision support system based on stochastic comparisons, 15:38316 (R;US)

Advanced Neutron Source (ANS) Project progress report, 15:36818 (R;US)

Advances in air-stripper technology, 15:37612 (R;US)

Alternative Motor Fuel Use Model: Model theory and design and user's guide, 15:37159 (R;US)

An improved method for one-way dissection with singular diagonal blocks, 15:38330 (R;US)

Analysis of the VENUS-3 experiments, 15:36912 (R;US)

Analysis of wallboard containing a phase change material, 15:37116 (R;US)

Analytical Chemistry Division annual progress report for period ending December 31, 1989, 15:37334 (R;US)

Arsenal of democracy in the face of change: Issues underlying the implementation of industrial mobilization policy: Working paper No. 3, 15:37548 (R;US)

Assessing the potential environmental impacts of proposed rules affecting future electric power generation in the United States, 15:36901 (R;US)

Assessment of the energy conservation potential of active (variable thermal resistance and switchable absorptance) building thermal insulation systems, 15:37124 (R;US)

Automated sensitivity analysis with the Gradient Enhanced Software System (GRESS), 15:38329 (R;US)

Balancing the roles for conservation, coal, nuclear, and other energy systems, 15:37026 (R;US)

Biological (molecular and cellular) markers of toxicity: Semiannual technical progress report No. 3, October 1, 1989–March 31, 1990, 15:37677 (R;US)

Boiling/evaporative heat transfer from spheres in packed-bed thermal energy storage units: Final report, 15:37000 (R;US)

Building Thermal Envelope Systems and Materials (BTESM) and research utilization/technology transfer progress report for DOE Office of Buildings and Community Systems: Monthly progress report, 15:37122 (R;US)

Chemical Technology Division progress report for the period July 1, 1988 to September 30, 1989, 15:37327 (R;US)

Chlorofluorocarbon (CFC) technologies review of foamed-board insulation for buildings, 15:37123 (R;US)

Classification and disposal of radioactive wastes: History and legal and regulatory requirements, 15:36773 (R;US)

Classification of spent nuclear fuel (SNF), 15:36762 (R;US)

Commercial cool storage laboratory test procedure, 15:37001 (R;US)

Comprehensive Self-Assessment and Upgrade Program (CSAUP) performance objectives and criteria, 15:36806 (R;US)

Conceptual model for radiological performance assessment of low-level-radioactive-waste disposal facilities, 15:36782 (R;US)

Conventional wallboard with latent heat storage for passive solar applications, 15:37117 (R;US)

Crystal growth and deformation behavior of TiAl aluminides, 15:37193 (R;US)

Data summary report for fission product release test VI-3, 15:36944 (R;US)

Descriptions of research sites in the integrated forest study on effects of atmospheric deposition, 15:37678 (R;US)

Designing an AI-environment prototype for the automatic startup of EBR-II [Experimental Breeder Reactor-II], 15:36941 (R;US)

Designing equipment for use in gamma radiation environments, 15:36759 (R;US)

Determination of the stress distributions in a ceramic: Tensile specimen using numerical techniques, 15:37229 (R;US)

Development of surface treatments and alloy modifications for corrosion-resistant oxide scales, 15:36692 (R;US)

Diffuse absorbing beryllium coatings produced by magnetron sputtering, 15:37182 (R;US)

Diffusion-accommodated grain boundary sliding in a polycrystal, 15:37179 (R;US)

DOE/NE University Program in robotics for advanced reactors: Program plan, FY 1990–FY 1994, 15:37375 (R;US)

Doses to railroad workers exposed to shipments of high-level radioactive waste, 15:36804 (R;US)

Effect of the equilibrium magnetic field on plasma edge fluctuations, 15:38016 (R;US)

Effect of the radial electric field on turbulence, 15:38018 (R;US)

Electron-impact ionization data for the nickel isonuclear sequence, 15:37715 (R;US)

Emergency preparedness at Oak Ridge National Laboratory, Oak Ridge, Tennessee, 15:36796 (R;US)

Environmental compliance assessment findings for Weldon Spring Site Remedial Action Program, 15:36805 (R;US)

Environmental regulatory update table, March 1990, 15:37013 (R;US)

Environmental regulatory update table, April 1990, 15:37014 (R;US)

Environmental regulatory update table, May 1990, 15:37015 (R;US)

Evaluating protective actions for chemical agent emergencies, 15:37560 (R;US)

Evidence of weak pair coupling in the penetration depth of bi-based high-T_c superconductors, 15:37976 (R;US)

Excitation and photon decay of giant multipole resonances, 15:37880 (R;US)

Experimental results concerning global observables from the CERN SPS heavy ion program, 15:37752 (R;US)

Experimental results from studies on nucleus-nucleus collisions at high energy, 15:37826 (R;US)

Feasibility of exclusive facilities for cars and trucks: Final report, 15:37140 (R;US)

Forced-to-natural convection transition tests in parallel simulated liquid metal reactor fuel assemblies, 15:36915 (R;US)

Forces shaping the energy required to support western hemisphere development, 15:37027 (R;US)

Formation of cubic Ll_2 phases from Al_3Ti and Al_3Zr by transition metal substitutions for Al, 15:37180 (R;US)

Free-living amoebae: Health concerns in the indoor environment, 15:37655 (R;US)

Global climate change and human health: Information needs, research priorities, and strategic considerations, 15:37563 (R;US)

Hardware development and initial subassembly test of a gas-fired Stirling/Rankine residential heat pump, 15:37145 (R;US)

High-resolution Z-contrast imaging in the stem, 15:37941 (R;US)

Human factors issues associated with advanced instrumentation and controls technologies in nuclear plants, 15:36939 (R;US)

IGORR-1: Proceedings of the first meeting of the international group on research reactors, 15:36947 (R;US)

Incoherent imaging of materials structure and composition by Z-contrast stem, 15:37281 (R;US)

Influence of thermal conditioning media on Charpy specimen test temperature, 15:37393 (R;US)

Integrated resource planning for electric and gas utilities, 15:37033 (R;US)

International aspects of Oak Ridge National Laboratory, 15:37024 (R;US)

Investigation of radiation effects in Hiroshima and Nagasaki using a general Monte Carlo-discrete ordinates coupling scheme, 15:37932 (R;US)

Johnston Atoll Chemical Agent Disposal System (JACADS): Volume 1, Final Second Supplemental Environmental Impact Statement (SSEIS) for the storage and ultimate disposal of the European chemical munition stockpile, 15:37617 (R;US)

Johnston Atoll Chemical Agent Disposal System (JACADS) Final Second Supplemental Environmental Impact Statement (SSEIS): Volume 2, Comments received from the public and agencies on the Draft Second Supplemental Environmental Impact Statement (SSEIS), 15:37618 (R;US)

Key issues in electric utility integrated resource planning: Findings from a nationwide study, 15:37038 (R;US)

KWOC [Key-Word-Out-of-Context] Index of US Nuclear Regulatory Commission Regulatory Guide Series, 15:37031 (R;US)

Large, orientation-dependent enhancements of critical currents in $Y_1Ba_2Cu_3O_{7-x}$ epitaxial thin films: Evidence for intrinsic flux pinning?, 15:37228 (R;US)

Light-duty vehicle MPG [miles per gallon] and market shares report, Model year 1989, 15:37139 (R;US)

Measured space-cooling electricity savings from standard energy conservation measures, radiant barriers, and high-efficiency window air conditioners, 15:37118 (R;US)

Measurement of energy performance in a small bank building, 15:37121 (R;US)
Mechanical properties of coatings and interfaces, 15:37225 (R;US)
Mechanical properties of silica coatings, 15:37226 (R;US)
Metals and Ceramics Division progress report for period ending September 30, 1989, 15:37192 (R;US)
Moisture-induced embrittlement of Fe_3Al, 15:36690 (R;US)
Multinucleon transfer reactions for the $^{50}Ti+^{93}Nb$ system at sub- and near-barrier energies, 15:37869 (R;US)
Multiple scattering theory for space filling potentials, 15:37987 (R;US)
Nucleus-nucleus collisions at 60 to 200 GeV/nucleon: Results from the WA80 experiment at CERN, 15:37881 (R;US)
On the implementation of complex many-to-many relations in focus, 15:38321 (R;US)
Operation of a mobile pilot-scale continuous countercurrent ion exchange system for treatment of low-level radioactive wastewaters, 15:36774 (R;US)
Operational readiness review plan for the radioisotope thermoelectric generator materials production tasks, 15:37043 (R;US)
Oxidation and sulfidation of Type 310S stainless steel at elevated temperatures, 15:37183 (R;US)
Parameter and fluence-rate covariances in lepricon, 15:36911 (R;US)
Pellets in large tokamaks TFTR and JET, 15:38255 (R;US)
Physics Division progress report for period ending September 30, 1989, 15:37836 (R;US)
Potential applications of an electron cyclotron resonance multicusp plasma source, 15:37716 (R;US)
PR-EDB: Power Reactor Embrittlement Data Base, version 1: Program description, 15:36907 (R;US)
Proceedings of the 1989 CESAR/CEA [Center for Engineering Systems Advanced Research/Commissariat a l'Energie Atomique] workshop on autonomous mobile robots (May 30–June 1, 1989), 15:38331 (R;US)
Program for preparing output data from a flow injection spectrometer for entry into AnaLis data base of the Analytical Chemistry Division, Oak Ridge National Laboratory, 15:37335 (R;US)
Proposed neutron activation analysis facilities in the Advanced Neutron Source, 15:36945 (R;US)
Recent advances in analytic combat simulation: From modeling to validation and beyond, 15:37545 (R;US)
Reentry planning: The technical basis for offsite recovery following warfare agent contamination, 15:37561 (R;US)
Report of a workshop on using remote sensing to estimate land use change, 15:37600 (R;US)
Resistive MHD turbulence, 15:38019 (R;US)
Resonance analysis and evaluation of the ^{235}U neutron induced cross sections, 15:37886 (R;US)
Resonance analysis of the ^{239}Pu neutron cross sections in the energy range 300 to 2000 eV, 15:37885 (R;US)
Scheduling Algorithm for Improving Lift (SAIL): Documentation for initial operating capability, 15:37547 (R;US)
Semiclassical eigenenergies in the wake of fast ions in solids, 15:37943 (R;US)
Sources and consequences of hypothetical bias in economic analyses of risk behavior: Draft, 15:37009 (R;US)
Stiffness control of teleoperators with redundant, dissimilar kinematics, 15:37373 (R;US)
Sulfur cycling and fluxes in temperate dimictic lakes, 15:37613 (R;US)
Synthesis of high purity sinterable silicon carbide powder: Final report, 15:37237 (R;US)
The 12th Werner Brandt international conference on the penetration of charged particles in matter, 15:37942 (R;US)
The advanced neutron source reactor: An overview, 15:36816 (R;US)
The federal government should do more to improve US energy efficiency, 15:37030 (R;US)
The GAMMASPHERE, 15:37515 (R;US)
The market penetration of energy-efficiency programs, 15:37037 (R;US)
Time resolved techniques: An overview, 15:37538 (R;US)
TNT [trinitrotoluene] metabolites in animal tissues: Quarterly technical progress report No. 6, January 1–March 31, 1990, 15:37676 (R;US)
Training scientists and engineers for the year 2000: Testimony before the Subcommittee on Science, Technology, and Space , Committee on Commerce, Science, and Transportation, United States Senate, 15:37154 (R;US)
Two-dimensional position-sensitive detectors for small-angle neutron scattering, 15:37530 (R;US)
Vacuum outgassing from diffuse-absorptive baffle materials, 15:37181 (R;US)
Weldability of iron aluminides, 15:36691 (R;US)
Workshop on scientific and industrial applications of free electron lasers, 15:37539 (R;US)
[Advanced technologies for water-cooled reactors]: Foreign trip report, May 24–June 12, 1988, 15:36985 (R;US)
[Atomic and molecular data for metallic impurities in fusion plasmas]: Foreign trip report, May 15–21, 1990, 15:38031 (R;US)
[Automation and new technology]: Foreign trip report, August 31, 1988–September 12, 1988, 15:38326 (R;US)
[Biological effects of atomic radiation]: Foreign trip report, May 11–19, 1989, 15:37671 (R;US)
[Biotechnology and photosynthesis]: Foreign trip report, June 28–July 14, 1988, 15:36833 (R;US)
[Computer vision and robotics]: Foreign trip report, January 22, 1989–January 28, 1989, 15:38328 (R;US)
[Conference on vector and parallel computing]: Foreign trip report, May 31, 1988–June 14, 1988, 15:38322 (R;US)
[Control of radiation sources]: Foreign trip report, September 24–October 2, 1988, 15:37016 (R;US)
[Cooperative research in the area of nuclear physics]: Foreign trip report, May 13–June 12, 1988, 15:37837 (R;US)
[Discrete kinetic theory, lattice gas dynamics and foundations of hydrodynamics]: Foreign trip report, September 17–October 2, 1988, 15:37741 (R;US)
[Environmental toxicology]: Foreign trip report, November 11–21, 1988, 15:37674 (R;US)
[Health risk assessment on environmental, occupational, and life style hazards]: Foreign trip report, December 12–30, 1988, 15:37675 (R;US)
[Heavy-ion nuclear reactions]: Foreign trip report, June 10, 1988–August 2, 1988, 15:37899 (R;US)
[International conference on free and moving boundary problems]: Foreign trip report, October 9, 1988–October 23, 1988, 15:38327 (R;US)
[International conference on radiation shielding]: Foreign trip report, September 11–16, 1988, 15:37931 (R;US)
[Liquid metal reactor/fast breeder reactor research and development]: Foreign trip report, June 4, 1990–June 9, 1990, 15:36927 (R;US)
[Low frequency electromagnetic fields and public health]: Foreign trip report, April 30–May 8, 1988, 15:37686 (R;US)
[Multiphoton spectroscopy of molecules]: Foreign trip report, May 16, 1988–June 1, 1988, 15:37714 (R;US)
[Nuclear power engineering in space]: Foreign trip report, May 11, 1990–June 3, 1990, 15:36932 (R;US)
[Nuclear waste management]: Foreign trip report, October 6, 1988–November 6, 1988, 15:36781 (R;US)
[Optimal design and analysis of experiments]: Foreign trip report, July 22–29, 1988, 15:38323 (R;US)
[Optimal design and analysis of experiments]: Foreign trip report, July 16–August 5, 1988, 15:38324 (R;US)
[Packaging regulations for chemical explosives]: Foreign trip report, January 26, 1988–February 1, 1988, 15:37552 (R;US)
[Passive monitoring of nuclear systems]: Foreign trip report, May 18–30, 1988, 15:36940 (R;US)
[Radiation materials science in the Soviet Union]: Foreign trip report, May 19–31, 1990, 15:37290 (R;US)
[Radiation protection]: Foreign trip report, April 8–16, 1988, 15:37670 (R;US)
[Radiopharmaceutical chemistry]: Foreign trip report, June 28–July 9, 1988, 15:37652 (R;US)
[Regulations for the safe transport of radioactive material]: Foreign trip report, September 27–30, 1988, 15:36761 (R;US)

[Symposium on dynamic particle-condensed matter interactions]: Foreign trip report, November 28, 1988–December 9, 1988, 15:37950 (R;US)
[Symposium on the Analytic Hierarchy Process]: Foreign trip report, September 2, 1988–September 11, 1988, 15:38325 (R;US)
[The decay properties of neutron-deficient hafnium isotopes]: Foreign trip report, May 19, 1990–May 31, 1990, 15:37876 (R;US)
[Theoretical techniques for dynamics studies of polymers]: Foreign trip report, July 30–August 22, 1988, 15:37289 (R;US)
[Thermal reactor safety]: Foreign trip report, October 2–13, 1988, 15:36986 (R;US)
[Understanding the variety of nuclear excitations]: Foreign trip report, May 19–26 1990, 15:37838 (R;US)
[Waste immobilization technology]: Foreign trip report, March 16–April 8, 1988, 15:36780 (R;US)

Oak Ridge National Lab., TN (USA). Carbon Dioxide Information Analysis Center
A plan for intermodel comparison of atmospheric CO_2 projections with uncertainty analysis, 15:37571 (R;US)

Oak Ridge Y-12 Plant, TN (USA)
Cold fusion studies: Part 1, Preliminary results from an investigation of the possibility of electrochemically induced fusion of deuterium in palladium and titanium cathodes, 15:38007 (R;US)

Office National d'Etudes et de Recherches Aerospatiales (ONERA), 92 - Chatillon (France)
Dynamic tests of wind turbine metallic blades (Lamboley process), 15:36875 (R;FR;In French)
Study and development of a mounted complier for wind turbines, 15:36876 (R;FR;In French)

Office of Radiation Programs, Washington, DC (USA)
Economic-assessment Environmental Impact Statement. NESPAHs (National Emission Standards for Hazardous Air Pollutants) for radionuclides. Background information document. Volume 3, 15:37577 (R;US)
EIS (Environmental Impact Statement) NESHAPs (National Emission Standards for Hazardous Air Pollutants) for Radionuclides, 15:37574 (R;US)
Radon-measurement comparison study, Butte, Montana-68 homes, 15:37573 (R;US)
Risk-assessments Appendixes Environmental Impact Statement. NESHAPs (National Emission Standards for Hazardous Air Pollutants) for Radionuclides. Background information document. Volume 2. Appendixes, 15:37576 (R;US)
Risk-assessments Environmental Impact Statement. NESHAPs (National Emission Standards for Hazardous Air Pollutants) for radionuclides. Background information document. Volume 2, 15:37575 (R;US)

Office of Science and Technology Policy, Washington, DC (USA)
High-temperature superconductivity: Perseverance and cooperation on the road to commercialization, 15:37981 (R;US)

Office of the Deputy Under Secretary of Defense for Policy, Washington, DC (USA)
Special nuclear material information, security classification guidance. Instruction, 15:36813 (R;US)

Ohio State Univ. Research Foundation, Columbus, OH (USA). Dept. of Microbiology
Structure and regulation of methanogen genes: Progress report, July 1, 1987–June 30, 1989, 15:37630 (R;US)

Ohio State Univ. Research Foundation, Columbus, OH (USA). Dept. of Physics
[Theory of exotic superconducting and normal states of heavy electron and high T_c materials]: [Progress report], 15:37977 (R;US)

Ohio State Univ., Columbus, OH (USA). Dept. of Mechanical Engineering
An accelerator neutron source for BNCT [Boron Neutron Capture Therapy]: Progress report, 15 July 1989–15 March 1990, 15:37644 (R;US)

Old Dominion Univ., Norfolk, VA (USA)
Application of the results of carbon pellet modeling to the problem of plasma penetration, 15:38017 (R;US)

Oregon State Univ., Corvallis, OR (USA)
Research on CO_2-induced climate change: Final report, 15:37566 (R;US)

Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics
Proceedings of the workshop on nuclear structure by gamma spectroscopy, 15:37908 (R;JP;In Japanese)

Ott Engineering, Inc., Bellevue, WA (USA)
Inexpensive cross-flow hydropower turbine at the Arbuckle Mountain Hydroelectric Project: Field test report, 15:36826 (R;US)

P

Pacific Northwest Lab., Richland, WA (USA)
An evaluation of the environmental fate and behavior of munitions materiel (TNT, RDX) in soil and plant systems: Environmental fate and behavior of TNT [trinitrotoluene]: Final report, 15:37687 (R;US)
Analysis of air-to-air heat exchanger performance data taken under the Residential Standards Demonstration Program, 15:37128 (R;US)
Basalt Waste Isolation Project exploratory shaft site: Final reclamation report, 15:37601 (R;US)
Benchmarking of energy time series, 15:37008 (R;US)
Crucible melts and bench-scale ISV [in situ vitrification] tests on simulated wastes in INEL [Idaho National Engineering Laboratory] soils, 15:36786 (R;US)
Hanford Environmental Dose Reconstruction Project: Monthly report, 15:37579 (R;US)
Initial tests on in situ vitrification using electrode feeding techniques, 15:36787 (R;US)
Interim report on low-cost cesium radiation sources from Hanford Waste Management Program, 15:36815 (R;US)
Multicomponent case weights for the 1985 resample of the 1983 Pacific Northwest residential energy survey, 15:37126 (R;US)
Techniques for multivariate sample design, 15:36729 (R;US)
The Residential Building Characteristics On-Site Inspection: Summary report, 15:37127 (R;US)
UNSAT-H Version 2.0: Unsaturated soil water and heat flow model, 15:36784 (R;US)
Viscosity, electrical conductivity, and cesium volatility of ORNL [Oak Ridge National Laboratory] vitrified soils with limestone and sodium additives, 15:36785 (R;US)

Parameter, Inc., Elm Grove, WI (USA)
Closeout of IE Bulletin 84-03: Refueling cavity water seal: Final report, 15:36979 (R;US)

Paris-11 Univ., 91 - Orsay (France)
Synthesis and characterization of ruthenium fluorides and oxide fluorides with high oxidation states, 15:37347 (R;FR;In French)
The measurability, by means of the DELPHI detector, of the Z^0 mass and width from the $e^+e^- \rightarrow \mu^+\mu^-\gamma_1...\gamma_n$ (muons) reaction, 15:37774 (R;FR;In French)

Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire
A stochastic model of depolarization enhancement due to large energy spread in electron storage rings, 15:37457 (R;FR)
Electron sources, 15:37712 (R;FR)
First evidence for direct Cp violation, 15:37767 (R;FR)
LAL contributions to the 1st EPAC conference, 15:37427 (R;FR)
New DM2 results on D/f_1(1285) and ι/η(1440), 15:37766 (R;FR)
Positron sources, 15:37711 (R;FR)
Present status of the NA31 experiment, 15:37771 (R;FR)
Selected topics from NA14': charm production and new results on D_s decays, 15:37769 (R;FR)
Selected topics on B physics at Lep, 15:37772 (R;FR)
Study of a positron source generated by photons from ultrarelativistic channeled particles, 15:37710 (R;FR)
Study of the J/Ψ decay into five pions, 15:37764 (R;FR)
The π, K, proton electromagnetic form factors and new related DM2 results, 15:37768 (R;FR)
The J/$\Psi \rightarrow$ vector+pseudoscalar decays and the η, η' quark content, 15:37765 (R;FR)
The search of the top quark in the UA2' experiment, 15:37770 (R;FR;In French)

Paris-6 Univ., 75 (France)
Propagation in an adsorbing porous medium of a mixture of anionic and non-ionic surfactants, 15:36725 (R;FR;In French)

Study of the muonic channel of $e^+e^- \rightarrow \mu^+\mu^-$ (γ) for the DELPHI experiment: radiative corrections and performance of trigger and reconstruction systems, 15:37776 (R;FR;In French)
Synthesis of organolanthanides by metal addition on insaturated substrates in ether and reactivity, 15:37348 (R;FR;In French)
The search of the top quark in the UA2' experiment, 15:37770 (R;FR;In French)
Ultrasonic signal processing and B-SCAN imaging for nondestructive testing. Application to under - cladding - cracks, 15:36936 (R;FR;In French)

Paris-6 Univ., 75 (France). Lab. de Physique Nucleaire et de Hautes Energies
Data acquisition system realization for H1 experiment, 15:37527 (R;FR;In French)
Electromagnetic radiative corrections at LEP-SLC energies for experimentalists, 15:37775 (R;FR)
Study of the muonic channel of $e^+e^- \rightarrow \mu^+\mu^-$ (γ) for the DELPHI experiment: radiative corrections and performance of trigger and reconstruction systems, 15:37776 (R;FR;In French)

Paris-7 Univ., 75 (France)
Acceleration and propagation of cosmic rays. Production, oscillation and detection of neutrinos, 15:37691 (R;FR;In French)
Contribution on the study of light non methane hydrocarbons sources in the atmosphere, 15:37569 (R;FR;In French)
Data acquisition system realization for H1 experiment, 15:37527 (R;FR;In French)

Pennsylvania State Univ., University Park, PA (USA). Dept. of Chemistry
Transition metal mediated transformations of small molecules: Annual progress report, December 1, 1989–November 30, 1990, 15:37340 (R;US)

Pennsylvania State Univ., University Park, PA (USA). Materials Research Lab.
Twin boundaries, interfaces and modulated structures in martensites: Annual progress report No. 5, July 1, 1989–June 30, 1990, 15:37184 (R;US)

Perpignan Univ., 66 (France)
ARC: Chemical heat pumps, 15:37125 (R;FR;In French)

Poitiers Univ., 86 (France)
Contribution to the study of low temperature pyrolysis of Gardanne coal, 15:36698 (R;FR;In French)
Follow-up of the regional energy conservation politics. Methods and illustration with the case of Charente-Poitou, 15:37006 (R;FR;In French)
Study of the destruction of coke and of its precursors in presence of hydrogen on platinum base catalysts, 15:36728 (R;FR;In French)

Polytechnic Inst. of New York, Brooklyn, NY (USA). Dept. of Physics
X-ray crystal devices for measuring compression and stability of laser fusion targets: Final report, 15:38020 (R;US)

PRC Environmental Management, Inc., Chicago, IL (USA)
Technology evaluation report: SITE program demonstration of the Ultrox International ultraviolet radiation/oxidation technology, 15:37619 (R;US)

Princeton Univ., NJ (USA). Plasma Physics Lab.
Error analysis of a new asymmetric Abel-inversion method, 15:38032 (R;US)
Influence of MHD effects and edge conditions on ITER helium ash accumulation and sustained ignition, 15:38035 (R;US)
Measurement of iron transport in TFTR [Tokamak Fusion Test Reactor] by charge exchange recombination spectroscopy, 15:38036 (R;US)
Measurements of radial profiles of He^{2+} transport coefficients on TFTR [Tokamak Fusion Test Reactor], 15:38034 (R;US)
Neutral beam emission spectroscopy diagnostic for measurement of density fluctuations on the TFTR tokamak, 15:38033 (R;US)

Purdue Univ., Lafayette, IN (USA). Dept. of Agricultural Engineering
Comparison of ethanol recovery processes from an immobilized cell reactor-separator, 15:37144 (R;US)
Scale-up and performance of an immobilized cell reactor separator for the production of ethanol from whey lactose, 15:36821 (R;US)

Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering
Macromolecular coal structure as revealed by novel diffusion tests: Quarterly technical report, January 15, 1990–April 15, 1990, 15:36703 (R;US)

R

Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)
Estimating the parameters of a sporadically observed queue, 15:38317 (R;US)

Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA). Health Physics Dept.
Onsite environmental report for the Nevada Test Site, January 1988–December 1988, 15:37567 (R;US)

Reynolds Electrical and Engineering Co., Inc., Mercury, NV (USA)
Distribution, habitat and habits of the desert tortoise (Gopherus agassizii) in the eastern Mojave Desert, 15:37595 (R;US)

RhoMed, Inc., Albuquerque, NM (USA)
Improved method for the direct labeling of antibodies with Tc-99m, 15:37647 (R;US)
One step Tc-99m labeling of antibodies for use in inflammation imaging, 15:37646 (R;US)

Rijksuniversiteit Utrecht (Netherlands). Inst. voor Aardwetenschappen
Reversibility of interaction of cesium with clay minerals, mud suspensions, and sediments of Dutch surface water bottom: Final report cesium project by request of DBW/RIZA, 15:37602 (R;NL;In Dutch)

Risoe National Lab., Roskilde (Denmark). Chemistry Dept.
Geochemical criteria for reservoir quality variations in chalk from the North Sea, 15:36743 (R;DK)

Risoe National Lab., Roskilde (Denmark). Physics Dept.
Physics Department. Annual progress report 1 January - 31 December 1989, 15:37952 (R;DK)

Rochester Univ., NY (USA)
Magnetic fields and behavior: Annual performance report, 1989–1990, 15:37685 (R;US)

Rochester Univ., NY (USA). Dept. of Biophysics
[Drug-DNA interactions studied by x-ray crystallography]: [Progress report], 15:37636 (R;US)

Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant
Fabricating vanadium sheet to improve symmetry of drawn parts, 15:37195 (R;US)

Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research
Diffusion-driven currents in a Z-pinch, 15:38051 (R;SE)
Experimental studies of equilibrium in the toroidal Extrap T1 experiment, 15:38041 (R;SE)
Extrap interchange stability, 15:38043 (R;SE)
Impurity behaviour in the EXTRAP-T1 pinch experiment studied by VUV spectroscopy, 15:38048 (R;SE)
Ion heat conduction losses in Extrap, 15:38044 (R;SE)
Lower pinch radius limit in EXTRAP, 15:38050 (R;SE)
Plasma position from ring current measurements in Extrap T1, 15:38045 (R;SE)
Poloidal rotation asymmetry and electric field effects at the edge of a divertor TOKAMAK, 15:38042 (R;SE)
The effect of the radial electric field on the L-H mode transition in Tokamaks, 15:38047 (R;SE)
Thomson scattering measurements on the high beta pinch Extrap-T1, 15:38046 (R;SE)
Upper pinch radius limit in EXTRAP, 15:38049 (R;SE)

Rutgers–the State Univ., New Brunswick, NJ (USA). Dept. of Biochemistry and Microbiology
Cellulase: A key enzyme for fermentation feedstocks: Progress report, September 1, 1987–August 31, 1988, 15:37631 (R;US)
Cellulase: A key enzyme for fermentation stocks: Final report, 1987–1989, 15:37632 (R;US)
Cellulase: A key enzyme for fermentation stocks: Progress report, 1989–1990, 15:37633 (R;US)

Rutherford Appleton Lab., Chilton (UK)
Large amplitude waves and fields in plasmas, 15:38039 (R;GB)
Oscillator and system development on the VULCAN glass laser system for the plasma beat-wave program, 15:37444 (R;GB)
Particle physics experiments 1989, 15:37443 (R;GB)
Parton distributions extracted from data on deep-inelastic lepton scattering, prompt photon production and the Drell-Yan process, 15:37789 (R;GB)
QCD mixing effects in a gauge invariant quark model for photo- and electroproduction of baryon resonances, 15:37790 (R;GB)
Two theories of auroral electron acceleration, 15:37705 (R;GB)

S

Sandia National Labs., Albuquerque, NM (USA)
A human factors review of data entry devices, 15:38332 (R;US)
A laser-produced lithium ion source for pulsed-power inertial confinement fusion, 15:38261 (R;US)
A model for transient natural convection in a vertical cylinder with sidewall heating, 15:36720 (R;US)
A performance evaluation of biometric identification devices, 15:38346 (R;US)
A protocol to set up shared secret schemes without the assistance of a mutually trusted party, 15:38345 (R;US)
A repetitive, one microsecond, thirty-five kilojoule, two hundred kilovolt pulse generator, 15:37408 (R;US)
A virtual sensor approach to robot kinematic identification: Theory and experimental implementation, 15:37378 (R;US)
Adsorption of spent fuel storage pool contaminants into metal surfaces, 15:37383 (R;US)
Analysis and modelling of improved accelerating cavities for the Recirculating Linear Accelerator (RLA), 15:37458 (R;US)
Annular core research reactor high flux neutron radiography facility, 15:36949 (R;US)
Application of InAlAs/GaAs superlattice alloys to GaAs solar cells, 15:37296 (R;US)
Application of parallel computing to the Monte Carlo simulation of electron scattering in solids: A rapid method for profile deconvolution, 15:37953 (R;US)
Chemical and biodesulfurization systems for removal of organic sulfur from coal: A critical review, 15:36702 (R;US)
Design of a light-ion-beam driver for the Laboratory Microfusion Facility, 15:38262 (R;US)
Developing convection above a finite horizontal surface, 15:37388 (R;US)
Development and field testing of the high-temperature borehole televiewer, 15:37536 (R;US)
Engineering-scale experiments of solar photocatalytic oxidation of trichloroethylene, 15:36856 (R;US)
Evaluation of a potential borehole televiewer technique for characterizing lost circulation zones, 15:36871 (R;US)
Evolution of structure and viscoelasticity in diethanolamine-cured epoxy, 15:37294 (R;US)
Experimental and computational investigation of the fundamental mechanisms of cratering, 15:37399 (R;US)
Guidance and targeting for the strategic target system, 15:37557 (R;US)
Hypervelocity explosive launchers, 15:37549 (R;US)
Information engineering: Sandia's Computer Integrated Manufacturing (CIM) database, 15:38313 (R;US)
Integration of model-based and sensor-based control for a two-link flexible robot arm, 15:37382 (R;US)
Laser techniques for studying chemical vapor deposition, 15:37239 (R;US)
Literature review of cask exterior surface contamination with application to a nuclear repository, 15:37379 (R;US)
Microsensor research, 15:37409 (R;US)
Molecular dynamics simulations of grain-boundary diffusion for varying tilt angle geometries, 15:37196 (R;US)
Monocular 3D vision for a robot assembly environment, 15:37381 (R;US)
New diagnostic developments for intense ion beam measurements on PBFA-2, 15:38040 (R;US)
Performance of magnetically injected plasma opening switches for the Particle Beam Fusion Accelerator 2 (PBFA 2), 15:38263 (R;US)
Performance testing and qualification of Sandia's third baseline photovoltaic concentrator module, 15:36837 (R;US)
Photovoltaic concentrator module technology, 15:36835 (R;US)
Preliminary identification of scenarios that may affect the escape and transport of radionuclides from the Waste Isolation Pilot Plant, southeastern New Mexico, 15:36789 (R;US)
Recent developments in the CONTAIN-LMR code, 15:36987 (R;US)
Recovery of high field GaAs photoconductive semiconductor switches, 15:37410 (R;US)
Redundant and independent containment and surveillance systems, 15:36814 (R;US)
Reflux pool-boiler as a heat-transport device for Stirling engines: On-sun test program results, 15:36847 (R;US)
Reliability of photovoltaic concentrator modules, 15:36836 (R;US)
Research on design and fabrication of high-efficiency solar cells, 15:37293 (R;US)
Results of the design and testing of a porous ceramic absorber for a volumetric air receiver, 15:36846 (R;US)
Sandia Sorption Data Management System, Version 2 (SSDMS II): User's manual, 15:36788 (R;US)
Selecting appropriate test targets for portal weapons detection, 15:37380 (R;US)
Short-range structure of fluorine-modified phosphate glass, 15:37292 (R;US)
Simulation fidelity in reactor irradiation of electronics, 15:37407 (R;US)
Sol-gel coating on acoustic wave devices: Thin film characterization and chemical sensor development, 15:37238 (R;US)
Spherical element bulking mechanisms for modeling blasting induced rock motion, 15:36754 (R;US)
StateGEN/StateNET and DOT guidelines: Tools for highway routing of hazardous materials, 15:36763 (R;US)
STL [Simulation Technology Laboratory] Global Control System, technical reference, 15:37499 (R;US)
Superconducting La_2CuO_{4+x} prepared by oxygenation at high pressure: A Raman scattering study, 15:37242 (R;US)
Temporal characterization of the 19-MV, 700-kA HERMES III electron beam, 15:37445 (R;US)
The compact linear accelerator program at Sandia National Laboratories, 15:37446 (R;US)
The development and characterization of ion exchange membranes for selected electrochemical power sources, 15:37002 (R;US)
The effects of hydrolysis and additive conditions on the gel-to-ceramic conversion of sol-gel derived $PbTiO_3$, 15:37240 (R;US)
The EISI [Elemental and Interplanar Spacing Index] index—A search/match tool for electron diffraction phase analysis, 15:38347 (R;US)
The greenhouse effect and acid rain: A tutorial, 15:37580 (R;US)
The potential impact of conservation and alternative energy sources on carbon dioxide emissions, 15:37017 (R;US)
The repetitive high energy pulsed power module, 15:37411 (R;US)
The synthesis of solar radiation data for sizing stand-alone photovoltaic systems, 15:36844 (R;US)
Thermal effects on the Josephson series-array voltage standard, 15:37412 (R;US)
Thermal expansion of beta-eucryptite filled bismaleimide and glass/bismaleimide composites, 15:37295 (R;US)
Transportation accidents/incidents involving radioactive materials, (1971–1989), 15:36807 (R;US)
Trends in dish-Stirling solar receiver designs, 15:36859 (R;US)
Wear mechanisms of amorphous carbon and zirconia coatings on rigid disk magnetic recording media, 15:37241 (R;US)

Sandia National Labs., Livermore, CA (USA)
Compendium of material test results on HY-130 and Ti-3Al-2V metals in support of United States Navy programs: Interim report, 15:37197 (R;US)

Schafer (W.J.) Associates, Inc., Chelmsford, MA (USA)
A plan for the study of the costs and environmental impact of fusion compared with alternative energy sources: Final report, 15:38274 (R;US)

Science Applications International Corp., Albuquerque, NM (USA)
Preliminary identification of scenarios that may affect the escape and transport of radionuclides from the Waste Isolation Pilot Plant, southeastern New Mexico, 15:36789 (R;US)

Science Applications International Corp., McLean, VA (USA)
Bilateral agreements providing negative security assurances to states party to the Nuclear Non-Proliferation Treaty, 15:37161 (R;US)
Constitutional implications of implementing a chemical weapons convention, 15:37559 (R;US)
Country statements on the nuclear non-proliferation treaty, Article 6, 15:37160 (R;US)
Department of Energy Strategic Defense Initiative programs: Potential programmatic and facility impacts due to a prospective defense and space treaty, 15:37554 (R;US)

Sloan-Kettering Inst. for Cancer Reserch, New York, NY (USA). Dept. of Medical Physics
Activation of oncogenes by radon progeny and x-rays, 15:37665 (R;US)

Solar Energy Research Inst., Golden, CO (USA)
Energy storage and distribution program summary: Volume 2, Research summaries, Fiscal year 1989, 15:37021 (R;US)
Passive solar systems performance under conditions in Bulgaria, 15:36828 (R;US)
SERI Solar Radiation Resource Assessment Project: FY 1989 annual progress report, 15:36827 (R;US)
The effects of urban air pollution on solar radiation, 15:36829 (R;US)

South Carolina Univ., Columbia, SC (USA). Dept. of Biological Sciences
Herbivore responses to plants grown in enriched carbon dioxide atmospheres: Progress report, 15:37658 (R;US)

Southwest Research Inst., San Antonio, TX (USA)
An investigation of amine-induced stress corrosion cracking of steels in natural gas treatment plants: Final report, 15:36744 (R;US)

Spire Corp., Bedford, MA (USA)
Dating of lithic artifacts by counting radon-produced particle tracks. Phase 1. Final report, 15:37688 (R;US)

Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)
Recommendations for the design, manufacture and construction of ventilation systems in nuclear power plants with pressurized water reactors, 15:37940 (R;DD;In German)

Stanford Linear Accelerator Center, Menlo Park, CA (USA)
A finite, rational model for the EPR-Bohm experiment, 15:37812 (R;US)
B-Factory mechanical utilities operation without SLC, 15:37485 (R;US)
Determination of ϵ, β, α from an arbitrary number of beam size measurements, 15:37459 (R;US)
Estimate of allowable beam current at 12 GeV, 15:37505 (R;US)
Influence of collective effects on the performance of high-luminosity colliders, 15:37453 (R;US)
IR design and parameters of APIARY VI, 15:37454 (R;US)
Object oriented programming, 15:38333 (R;US)
Parameters and requirements for the B Factory vacuum chamber, 15:37507 (R;US)
Progress report on the use of hybrid silicon pin diode arrays in high energy physics, 15:37533 (R;US)
Seepage into PEP tunnel, 15:37506 (R;US)
Sizing the vacuum chambers conservatively, 15:37484 (R;US)
The Reason Project, 15:38334 (R;US)

Stanford Research Inst., Menlo Park, CA (USA)
The silicon strip detector at the Mark 2, 15:37534 (R;US)

Stanford Univ., CA (USA)
Transport characteristics of concentrated slurries: Final technical report, 15:37386 (R;US)

State Univ. of New York, Stony Brook, NY (USA). Dept. of Mechanical Engineering
Theoretical studies of multicomponent mixtures: Phase equilibrium and transport: Progress report, September 1, 1988–May 15, 1990, 15:37282 (R;US)

State Univ. of New York, Stony Brook, NY (USA). Dept. of Physics
Research in theoretical nuclear physics: Progress report, 15:37893 (R;US)

Statens Energiverk, Stockholm (Sweden)
Pressure measurements on a 5.35 m hawt in CARDC wind tunnel compared to theoretical pressure distributions, 15:36878 (R;SE)

Structural Integrity Associates, Inc., San Jose, CA (USA)
Detection and control of microbiologically influenced corrosion: An extension of the sourcebook for microbiologically influenced corrosion in nuclear power plants, 15:36935 (R;US)

Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden)
Characterization of fracture zone 2, Finnsjoen study-site, 15:36791 (R;SE)
Diffusion of Am, Pu, U, Np, Cs, I and Tc in compacted sand-bentonite mixture, 15:37603 (R;SE)
SKB annual report 1988: Including summaries of technical reports issued during 1988, 15:36790 (R;SE)
Some notes on diffusion of radionuclides through compacted clays, 15:37604 (R;SE)

T

Technische Univ. Berlin (Germany, F.R.). Inst. fuer Angewandte Geophysik, Petrologie und Lagerstaettenforschung
Application of the absorption of seismic waves in hydrocarbon exploration, 15:36719 (R;DE)

Technische Univ. Berlin (Germany, F.R.). Inst. fuer Konstruktionslehre und Thermische Maschinen
Emission and biological activity of N-containing polycyclic aromatic compound as exhaust of Diesel engines, 15:37158 (R;DE;In German)

Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technischen Umweltschutz
Emission and biological activity of N-containing polycyclic aromatic compound as exhaust of Diesel engines, 15:37158 (R;DE;In German)

Technische Univ. Braunschweig (Germany, F.R.). Abt. fuer Angewandte Kern- und Neutronenphysik
Application of the absorption of seismic waves in hydrocarbon exploration, 15:36719 (R;DE)

Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Geophysik
Application of the absorption of seismic waves in hydrocarbon exploration, 15:36719 (R;DE)

Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik
Production and decay of the τ lepton, 15:37777 (R;DE;In German)

Tennessee Univ., Knoxville, TN (USA). Dept. of Chemistry
Effects of extracolumn convolution on preparative chromatographic peak shapes, 15:37330 (R;US)

Tennessee Univ., Knoxville, TN (USA). Dept. of Mechanical and Aerospace Engineering
Boiling/evaporative heat transfer from spheres in packed-bed thermal energy storage units: Final report, 15:37000 (R;US)

Tennessee Univ., Tullahoma, TN (USA). Space Inst.
Characterization of flow disturbances in a coal fired combustion flow train, 15:37040 (R;US)
EPA [Environmental Protection Agency] performance tests for particulate and SO_2 conducted at the DOE Coal-Fired Flow Facility, 15:37041 (R;US)

Tennessee Valley Authority, Chattanooga, TN (USA). Water Quality Dept.
Surface water resources issues analysis: Wheeler Reservoir watershed region, 15:37621 (R;US)

Tennessee Valley Authority, Knoxville, TN (USA)
Sixth annual Gatlinburg acid rain conference: Proceedings, 15:37679 (R;US)

Tennessee Valley Authority, Knoxville, TN (USA). Water Quality Dept.
Integrated regional resources management: Based on the experience of the Tennessee Valley Authority, 15:37018 (R;US)

Tennessee Valley Authority, Muscle Shoals, AL (USA). Chemistry and Radiological Services
Annual radiological environmental operating report, Sequoyah Nuclear Plant, 1989, 15:37583 (R;US)
Annual radiological environmental monitoring report, Watts Bar Nuclear Plant, 1989, 15:37581 (R;US)
Annual radiological environmental operating report, Browns Ferry Nuclear Plant, 1989, 15:37582 (R;US)

Texas Univ., Austin, TX (USA). Dept. of Chemical Engineering
Theoretical approach for enhanced mass transfer effects in-duct flue gas desulfurization processes: Quarterly report No. 7, January 1, 1990–March 31, 1990, 15:36898 (R;US)

Texas Univ., Austin, TX (USA). Dept. of Chemistry
Vectorial electron transfer on designed surfaces. Final report, February 1984-December 1989, 15:37291 (R;US)

Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study
A proposal to study double-Λ hypernuclei and H-dibaryon by using a 4π-type spectrometer, 15:37761 (R;JP)

TRIUMF, Vancouver, BC (Canada)
Leptonic CP violation in leptoquark models, 15:37794 (R;CA)
Recent results from rare kaon decay experiments, 15:37779 (R;CA)
The laser system of the optically pumped ion source at TRIUMF, 15:37500 (R;CA)

U

UKAEA Atomic Energy Establishment, Winfrith (UK)
TRAC-PF1 MOD1 post test calculations of the OECD LOFT Experiment LP-SB-1, 15:36981 (R;US)
TRAC-PF1/MOD1 post-test calculations of the OECD LOFT Experiment LP-SB-3, 15:36982 (R;US)

UKAEA Harwell Lab. (UK). Energy Technology Div.
Energy efficiency demonstration scheme: June 1988 review of ETSU portfolio, 15:37047 (R;GB)

UKAEA Harwell Lab. (UK). Materials Development Div.
On the use of oxides for thermoelectric refrigeration, 15:37042 (R;GB)

Umweltbundesamt, Berlin (Germany, F.R.)
Changes in terrestrial ecosystems after long-term exposure to airborne pollutants - studies on the effects of ozone and NO_x immissions on spontaneous vegetation. Final report, 15:37681 (R;DE;In German)
Dose-response-relationships for phytotoxic air pollutants, where no air quality standards have been established. Criteria for decision-making in special cases (TA Luft, 2.2.1.3), 15:37680 (R;DE;In German)
Emission and biological activity of N-containing polycyclic aromatic compound as exhaust of Diesel engines, 15:37158 (R;DE;In German)
Influence of reductions in deposition on the degree of acidification of soils and groundwater in forests - assessment of critical loads from the atmosphere. Final report, 15:37622 (R;DE;In German)
MAB-project 6 'Research for the ecological system Berchtesgaden': Climatological measurements at the Alpine National Park, wind systems and inversions. Disciplinary report FB 07 climatology, 15:37585 (R;DE;In German)
Modelling of the transport of air pollution in orographic regions like Northeast Bavaria, 15:37584 (R;DE;In German)

United Engineers and Constructors, Inc., Denver, CO (USA). Stearns-Roger Div.
Physical flow model study of the Ohio Power Company's 12-MW duct injection test facility in Beverly, Ohio: Topical report 10A, 15:36896 (R;US)

United Technologies Research Center, East Hartford, CT (USA)
Investigation of particulate formation during diesel spray combustion: Technical progress quarterly report, March 1–May 31, 1990, 15:37371 (R;US)

Uppsala Univ. (Sweden). Inst. of Physics
A TDC-PC based DPAC spectrometer, 15:37956 (R;SE)

USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Office of State and Local Assistance Programs
Compendium of Federal legislation, policies and procedures: Guidance for the administration of DOE grants and cooperative agreements, 15:37029 (R;US)

USDOE Assistant Secretary for Environment, Safety and Health, Washington, DC (USA)
Tiger Team Assessment of the Lawrence Livermore National Laboratory, 15:36798 (R;US)
Tiger Team assessment of the Savannah River Site, 15:37012 (R;US)

USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of the Deputy Assistant Secretary for Coal Technology
Alternative fuels program: Fiscal year 1990, Summary program plan, 15:37032 (R;US)

USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels
Annual outlook for US electric power 1990: Projections through 2010, 15:37035 (R;US)
Annual prospects for world coal trade 1990, 15:36718 (R;US)
Electric Power Monthly, March 1990, 15:37034 (R;US)
Electric trade in the United States, 1986, 15:37036 (R;US)

USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use
International petroleum statistics report, February 1990, 15:36731 (R;US)

USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas
Petroleum supply monthly, March 1990, 15:36730 (R;US)

USDOE Energy Information Administration, Washington, DC (USA). Office of the National Energy Information System
EIA Publications Directory, 1977–1989, 15:37004 (R;US)

USDOE Membrane Separation Systems Research Needs Assessment Group (USA)
Membrane separation systems—A research and development needs assessment: Executive summary: Volume 1, 15:37147 (R;US)
Membrane separation systems—A research and development needs assessment: Final report: Volume 2, 15:37148 (R;US)

USDOE Morgantown Energy Technology Center, WV (USA)
Three-dimensional capacitance imaging system, 15:36712 (R;US)

USDOE Office of Energy Research, Washington, DC (USA). Office of Program Analysis
Basic energy sciences: Summary of accomplishments, 15:37022 (R;US)
Membrane separation systems—A research and development needs assessment: Executive summary: Volume 1, 15:37147 (R;US)
Membrane separation systems—A research and development needs assessment: Final report: Volume 2, 15:37148 (R;US)

USDOE Office of Scientific and Technical Information, Oak Ridge, TN (USA)
Nuclear reactors built, being built, or planned: 1989, 15:36902 (R;US)
Nuclear reactors built, being built, or planned: 1989: Supplement, 15:36903 (R;US)

USDOE Richland Operations Office, WA (USA)
Hanford Waste Vitrification Plant foreign alternatives feasibility study: Revision 1, 15:36777 (R;US)

USDOE, Washington, DC (USA)
Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education: Volume 1, Overview and general waste management: Proceedings, 15:36772 (R;US)

V

Valtion Teknillinen Tutkimuskeskus, Espoo (Finland)
Characteristics of the IAEA correlation monitor material for surveillance programmes, 15:37199 (R;FI)

Eddy current inspection at the nuclear power plants, 15:37395 (R;FI;In Finnish)
Probabilistic system assessment code SYVAC/FI for safety analysis of nuclear waste disposal, 15:36792 (R;FI;In Finnish)
Safety and cost evaluation of nuclear waste management, 15:36794 (R;FI;In Finnish)
Sampling and monitoring of carbon-14 in gaseous effluents from nuclear facilities: Literature survey, 15:36793 (R;FI)

W

Washington Univ., St. Louis, MO (USA). School of Medicine
Positron Emission Tomography (PET): Final report, January 15, 1989–January 14, 1990, 15:37643 (R;US)
Welding Inst. of Canada, Oakville, ON (Canada)
Engineering critical assessment of girth welds in small diameter pipe: Final report, 15:36750 (R;CA)
Welding Inst., Cambridge (UK)
The significance of local hard zones on the outside of pipeline girth welds: Final report, 15:36735 (R;GB)
West Valley Nuclear Services Co., Inc., West Valley, NY (USA)
The use of the Deep Kerfer for thick, steel-reinforced concrete cutting, 15:36775 (R;US)
Verification of product quality from process control, 15:36776 (R;US)
West Virginia Univ., Morgantown, WV (USA). Dept. of Mechanical and Aerospace Engineering
A study of coal particle shape and three-body wear: Quarterly report, January 1990–March 1990, 15:36704 (R;US)
Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Dept.
138-kV six-phase Charleroi-Yukon Line uprating study for Allegheny Power Service Corporation, 15:36999 (R;US)
Westinghouse Electric Corp., Pittsburgh, PA (USA). Science and Technology Center
Advanced study in solid transport: Rheological behavior of dense suspension: Sixth quarterly report, January 1, 1990–March 31, 1990, 15:36711 (R;US)
Westinghouse Hanford Co., Richland, WA (USA)
Analysis of Beyond Design Basis Events for the Fast Flux Test Facility UO_2 core, 15:36989 (R;US)
Fuel aspects of Beyond Design Basis Event analyses for the Fast Flux Test Facility, 15:36928 (R;US)
Westinghouse Hanford Company environmental surveillance annual report – 200/600 Areas: Calendar year 1989, 15:37624 (R;US)
Wisconsin Univ., Madison, WI (USA)
An energy confinement study of the MST [Madison Symmetric Torus] reversed field pinch using a Thomson scattering diagnostic, 15:38022 (R;US)

Y

Yale Univ., New Haven, CT (USA). Dept. of Cellular and Molecular Physiology
Mechanisms and control of K^+ transport in plants and fungi, 15:37629 (R;US)
Yale Univ., New Haven, CT (USA). Dept. of Mechanical Engineering
Microstructural dependence of the cavitation damage function in FCC materials: Progress report, March 1, 1989–February 28, 1990, 15:37185 (R;US)

Personal Author Index

Authors' surnames are indexed in the form appearing in the publication cited; given names generally have been reduced to initials. For documents with multiple authors, each author name is indexed. The entry for a primary author (first author listed on an abstracted document) includes the full document title and citation number. Entries for other authors provide a cross-reference to the primary author. Also included is information on the document type, country of publication, and the document language listed in parentheses in the format (J;FR;In French and English). Accent marks are not input because of computer alphabetization. Spelling and transliteration follow standard conventions.

A

Abad, J.P., *See* Sanz, J.L., 15:37638

Abaouz, A., *See* Laval, J.P., 15:37171

Abbott, L.F., *See* Kirsch, L.E., 15:37753

Abdou, M.A., *See* Federici, G., 15:38121

Abdul-Rahim, Maha, *See* Othman, Ibrahim, 15:37936

Abenante, V., *See* Sarantites, D.G., 15:37865

Abeyta, E.E., *See* Vigil, A.S., 15:37550

Abou Yehia, H., Taking into account a reactivity accident in research reactors design, 15:36951 (R;FR;In French)

Accetta, F.S., Scalar-tensor gravitational effects on vacuum decay, 15:37817 (J;US)
See Steinhardt, P.J., 15:37700

Ackermann, A.L., Power Burst Facility/Boron Neutron Capture Therapy Program for Cancer Treatment: Monthly bulletin, Volume 4, No. 2, 15:37666 (R;US)

Ackerson, B.J., *See* Paulin, S.E., 15:37964

Acrivos, A., Transport characteristics of concentrated slurries: Final technical report, 15:37386 (R;US)
See Thovert, J.F., 15:37968

Adachi, M., A rotating catcher system (CAROT) for a decay study of projectile fragmentation, 15:37497 (RA;JP;In Japanese)

Adachi, Toshikazu, Polarization of lanthanum nucleus by dynamic polarization method, 15:37898 (RA;JP;In Japanese)

Adair, R.K., *See* Ohl, K.E., 15:37785

Adams, A., Hydrogeochemical investigations in support of well logging operations at the Zunil geothermal field, Guatemala, 15:36862 (R;US)
See Golf, F., 15:36864

Adams, B.L., Microstructural dependence of the cavitation damage function in FCC materials: Progress report, March 1, 1989–February 28, 1990, 15:37185 (R;US)

Adams, K.G., Literature review of cask exterior surface contamination with application to a nuclear repository, 15:37379 (R;US)

Adams, M.B., Root and foliar nutrient concentrations in loblolly pine: Effects of season, site, and fertilization, 15:37609 (J;US)

Adams, N.P., *See* Banerjee, A., 15:37362

Adcock, J., *See* Harjes, H.C., 15:37411

Additon, S.L., *See* Carter, J.C. III, 15:36965

Ade, H., X-ray spectromicroscopy with a zone plate generated microprobe, 15:37543 (J;US)

Adkins, D.R., *See* Diver, R.B., 15:36859

Adler, J., Resonant substructure in $K^-\pi^+\pi^+\pi^-$ decays of D^0 mesons, 15:37783 (J;US)

Adler, L., *See* Nagy, P.B., 15:37963

Adler, L.A., *See* Nicolis, N.G., 15:37871

Adler, L.K., Time resolved plasma characterization in a long conduction time planar plasma opening switch, 15:38085 (BA;US)

Adler, R.J., *See* Wilson, J.M., 15:37446

Adolf, D., Evolution of structure and viscoelasticity in diethanolamine-cured epoxy, 15:37294 (R;US)

Adolphsen, C., *See* Jacobsen, R., 15:37534

Adroguer, B., Heat transfer in reactor cavity during core-concrete interaction, 15:36909 (R;FR)

Advani, A., *See* Murr, L.E., 15:37203

Afnan, I.R., Hypertriton: $\Lambda \leftrightarrow \Sigma$ conversion and tensor forces, 15:37918 (J;US)

Ahlbom, K., Characterization of fracture zone 2, Finnsjoen study-site, 15:36791 (R;SE)

Ahlstrand, R., *See* Wallin, K., 15:37199

Akai, K., *See* Takeda, S., 15:37449

Akemoto, M., *See* Takeda, S., 15:37449

Akerman, M.A., *See* Becraft, W.R., 15:37432

Akers, D.W., *See* Jensen, S.M., 15:36970

Akiba, M., *See* Kuriyama, M., 15:38144

Akino, N., *See* Kuriyama, M., 15:38144

Albinsson, Y., Diffusion of Am, Pu, U, Np, Cs, I and Tc in compacted sand-bentonite mixture, 15:37603 (R;SE)

Alburger, D.E., Half-lives of ^{44}Ti and ^{207}Bi, 15:37867 (J;US)

Alcaraz, A., *See* Oh, M.S., 15:36757

Alcock, C.R., Late-time dissipation of primordial baryon-number fluctuations and nucleosynthesis, 15:37804 (J;US)

Alde, D.M., Nuclear dependence of dimuon production at 800 GeV, 15:37782 (J;US)

Aldrich, T.E., [Low frequency electromagnetic fields and public health]: Foreign trip report, April 30–May 8, 1988, 15:37686 (R;US)

Aleong, J., *See* Walsh, R.W., 15:37067

Alexander, D.J., Moisture-induced embrittlement of Fe_3Al, 15:36690 (R;US)

Alexander, J., Heavy flavor resonances and QED radiative corrections, 15:37799 (J;US)

Alexander, J.B., Distance learning conference proceedings, 15:38343 (R;US)

Alexander, K.B., *See* Williams, R.K., 15:37355

Alexeff, I., A visible plasma, 15:38065 (BA;US)

Alford, W.P., *See* Taddeucci, T.N., 15:37858

Allen, E.J., TRAC-PF1 MOD1 post test calculations of the OECD LOFT Experiment LP-SB-1, 15:36981 (R;US)
TRAC-PF1/MOD1 post-test calculations of the OECD LOFT Experiment LP-SB-3, 15:36982 (R;US)

Allen, H.L., *See* Adams, M.B., 15:37609

Allen, H.W., A human factors review of data entry devices, 15:38332 (R;US)

Allen, J.W., Density-of-states-driven transition from superconductivity to ferromagnetism in $Ce(Ru_{1-x}Rh_x)_3B_2$: Scenario for an exchange-split Kondo resonance, 15:37271 (J;US)
See Huang, H., 15:36892

Allen, M.A., Relativistic klystron research for linear colliders, 15:37475 (RA;US)
Relativistic klystron research for linear colliders, 15:37501 (R;US)

Allen, R., *See* Esterowitz, L., 15:37425

Allen, S., *See* Casper, T., 15:38276

Allison, M.J., *See* Grant, C.W., 15:38338

Allred, D.A., *See* Egert, C.M., 15:37182

Allred, R.E., Thermal expansion of beta-eucryptite filled bismaleimide and glass/bismaleimide composites, 15:37295 (R;US)

Allshouse, G.O., *See* Prestwich, K.R., 15:38262

Almagri, A.F., *See* Beckstead, J.A., 15:38285

Als-Nielsen, J., Physics Department. Annual progress report 1 January - 31 December 1989, 15:37952 (R;DK)

Altmann, H., A comparison between hypervapotron and multitube high heat flux beam stopping elements, 15:38131 (RA;US)
See Bickley, A.J., 15:38253

Alvegaard, T.A., Management and prognosis of patients with high-grade soft tissue sarcomas: An evaluation of a Scandinavian joint care program, 15:37648 (R;SE)
Amador, J., *See* Salvador, P., 15:37168
Amann, J.F., A search for $\mu \rightarrow e\gamma$ at the level of 10^{-13}, 15:37773 (R;US)
Amato, A., Magnetic field dependence of the specific heat of heavy-fermion $YbCu_{4.5}$, 15:37288 (R;US)
Pressure dependence of the specific heat of heavy-fermion $YbCu_{4.5}$, 15:37979 (R;US)
Specific heat of $La_{2-x}Sr_xCuO_4$: Volume fraction of superconductivity; possible structural transition at 45K, 15:37980 (R;US)
Ambjoern, J., The bosonic string represented as ϕ^3 graphs: New Monte Carlo simulations, 15:37809 (R;DK)
Amils, R., *See* Sanz, J.L., 15:37638
Amsler, C., *See* Bosshard, A., 15:37784
Anderson, D.F., Recent developments in high-speed, non-sampling electromagnetic calorimetry, 15:37519 (R;US)
Anderson, D.L., *See* Gordon, H.T., 15:36855
Anderson, E., *See* Ade, H., 15:37543
Anderson, F.S.B., *See* Rasmussen, D.A., 15:38062
Anderson, J., The breeding blanket interface (BBI) and the tritium systems test assembly (TSTA), 15:38105 (RA;US)
Anderson, J.D., Nuclear Ramsauer effect and the isovector potential, 15:37920 (J;US)
See Berger, J.F., 15:37888
Anderson, J.L., User's guide for SDIS [Spray-Dryer Information System]: A personal computer code for the design and evaluation of spray-dryer flue-gas-cleaning systems, 15:36893 (R;US)
See Bartlit, J.R., 15:38102
See Willms, R.S., 15:38101
Anderson, K.J., *See* Kolar, O.C., 15:36800
Anderson, O.A., *See* Purgalis, P., 15:38238
Anderson, P., *See* Kercher, J.R., 15:37586
Anderson, P.M., Neutron shielding system for the DIII-D research facility, 15:38227 (RA;US)
Anderson, R., *See* Carr, M.J., 15:38347
Ando, A., *See* Kaneko, O., 15:38240
Ando, Ainosuke, *See* Katayama, Ichiro, 15:37509
Ando, M., Plans for production of undulator X-rays on AR and its applications to material and biological sciences, 15:37944 (R;JP;In Japanese)
Ando, T., *See* Horie, T., 15:38228
See Horiike, H., 15:38164
See Nishi, M.F., 15:38098
See Okuno, K., 15:38104
Andraka, B., *See* Stewart, G.R., 15:37223
Andraka, C.E., Reflux pool-boiler as a heat-transport device for Stirling engines: On-sun test program results, 15:36847 (R;US)
See Diver, R.B., 15:36859
Andre, J.J., *See* Simon, J., 15:36834
Andreani, R., The 8 MW, 8 GHz FTU LHRH system: R and D and design status, 15:38160 (RA;US)
Andresen, B.D., *See* Angel, S.M., 15:37298
Andrews, A.E., *See* Alexander, J.B., 15:38343
Andritsos, F., Optimization of the poloidal transformer of ignitor, 15:38184 (RA;US)
Angel, S.M., Development of a drug assay using surface-enhanced Raman spectroscopy, 15:37298 (R;US)
Angelini, A., *See* Andritsos, F., 15:38184
Angelis, U. de, Large amplitude waves and fields in plasmas, 15:38039 (R;GB)
Angell, C.A., *See* Syed, R., 15:37301
Anno, K., *See* Loring, M., 15:38252
See Moriyama, S., 15:38236
Antonetti, A., *See* Orszag, A., 15:37186
Arai, M., *See* Watanabe, N., 15:37945
Arakawa, K., JT-60 operational experience and trouble analysis, 15:38158 (RA;US)
Araki, S., *See* Takeda, S., 15:37449
Arastoopour, H., *See* Carty, R.H., 15:36693
Archuleta, J., *See* Adams, A., 15:36862
Ardell, A.J., *See* Cheng, J., 15:37206
Arens, J.F., *See* Shapiro, S.L., 15:37533
Arepalli, S., *See* Robie, D.C., 15:37363
Argo, B.E., *See* Gouge, M.J., 15:38204
Arimilli, R.V., Boiling/evaporative heat transfer from spheres in packed-bed thermal energy storage units: Final report, 15:37000 (R;US)
Armijo, V., *See* Mischke, R.E., 15:37526
Armstrong, R.L., Propagation of high energy laser beams through metallic aerosols, 15:37416 (J;US)
Arnold, C. Jr., The development and characterization of ion exchange membranes for selected electrochemical power sources, 15:37002 (R;US)
Aronson, E.A., *See* Edenburn, M.W., 15:37017
Aronsson, D., *See* Hoek, M., 15:37516
Artru, X., *See* Chehab, R., 15:37710
Artuso, M., *See* Seth, K.K., 15:37860
Asghar, M., *See* Bouchenab, N., 15:37892
Ashworth, R.A., *See* Wilson, J.H., 15:37612
Assadi, S., *See* Beckstead, J.A., 15:38285
Assink, R.A., *See* Arnold, C. Jr., 15:37002
Asta, M., *See* Ceder, G., 15:37263
Atac, M., *See* Barletta, W.A., 15:37447
Attaya, H., Two dimensional LOCA (loss-of-coolant accident) analysis for fusion reactors, 15:38187 (RA;US)
See Gohar, Y., 15:38213
Atteridge, D.G., *See* Murr, L.E., 15:37203
Atwater, H.A., Island growth and coarsening in thin films—conservative and nonconservative systems, 15:37969 (J;US)
Atwood, W., The Reason Project, 15:38334 (R;US)
Auble, R.L., Excitation and fission decay of ^{238}U using the $(^{17}O,^{17}O')$ reaction, 15:37889 (J;US)
See Morsch, H.P., 15:37877
Auge, E., Present status of the NA31 experiment, 15:37771 (R;FR)
August, C., *See* Liu, Y.Y., 15:36961
Augustin, J.E., Study of the J/Ψ decay into five pions, 15:37764 (R;FR)
The J/Ψ → vector+pseudoscalar decays and the η, η' quark content, 15:37765 (R;FR)
Aukrust, T., Numerical investigation of a model for oxygen ordering in $YBa_2Cu_3O_{6+x}$, 15:37265 (J;US)
Avasthi, B.N., *See* Padmanaban, N., 15:37169
Avenhaus, R., Game theoretical analysis of safeguards effectiveness. Pt. 3. Equilibrium solutions, 15:36810 (R;DE)
Avioll, M.J. Jr., Nondestructive evaluation research progress in 1989: Proceedings from the tenth annual EPRI NDE information meeting, 15:36934 (R;US)
Awes, T.C., *See* Plasil, F., 15:37881
Axtell, S.C., Study of the mechanism of fast diffusion of cobalt in thorium by diffusion and internal friction measurements, 15:37210 (J;US)
Aycinena, S., *See* Goff, S., 15:36863
Ayyub, B.M., *See* Balkey, K.R., 15:36943
Azaiez, F., *See* Stephens, F.S., 15:37883
Azmy, Y.Y., *See* Protopopescu, V., 15:37545

B

Babcock, S., *See* Jansen, J.F., 15:37373
Babu, S., *See* Carty, R.H., 15:36693
Back, B.B., *See* Sanders, S.J., 15:37862
Baer, H.W., *See* Alde, D.M., 15:37782
Bahr, R., *See* Mizuno, K., 15:38057
Bai, Z., *See* Adler, J., 15:37783
Bailey, J.E., *See* Bieg, K.W., 15:38261
See Leeper, R.J., 15:38040
Bailey, J.L., *See* Liu, Y.Y., 15:36961
Bailey, W., *See* Combs, S.K., 15:38225
See Kupschus, P., 15:38203
Bairstow, R., Particle physics experiments 1989, 15:37443 (R;GB)
Balty, F.W., *See* Hammonds, C.J., 15:38237
Baker, C., *See* Ballard, E.O., 15:38111
Baker, R.W., Membrane separation systems—A research and development needs assessment: Executive summary: Volume 1, 15:37147 (R;US)

Membrane separation systems—A research and development needs assessment: Final report: Volume 2, 15:37148 (R;US)
Baker, W.R., Technological aspects in the production of a large aluminum shell, 15:38113 (RA;US)
The construction of the RFX vacuum vessel, 15:38139 (RA;US)
Baktash, C., *See* Plasil, F., 15:37881
See Sarantites, D.G., 15:37865
Bala, S.R., Engineering critical assessment of girth welds in small diameter pipe: Final report, 15:36750 (R;CA)
Balakrishnan, R., Geometric phase in the classical continuous antiferromagnetic Heisenberg spin chain, 15:37961 (J;US)
Balcomb, J.D., *See* Lekov, A.B., 15:36828
See Subbarao, K., 15:37132
Baldwin, G.T., *See* Leeper, R.J., 15:38040
Balhorn, R., *See* Felton, J.S., 15:37653
Balkanski, M., *See* Fusco, F.A., 15:37303
Balkey, K.R., Risk-based inspection guidelines, 15:36943 (J;US)
Ball, R.D., Baryons and ladders, 15:37788 (R;DK)
Ball, S.J., *See* Corcuera, R.P., 15:36941
Ballard, E.O., CPRF/ZTH front-end torus design and fabrication status, 15:38111 (RA;US)
Ballinger, R., Superstructure for a super tokamak: Alcator C-MOD, 15:38219 (RA;US)
Baltich, L.K., *See* Smit, F.J., 15:36689
Ban, Hidekazu, Shield for UTS, 15:37930 (RA;JP;In Japanese)
Banerjee, A., Dynamics of classical systems based on the principle of stationary action, 15:37362 (J;US)
Banerjee, M.K., *See* Ren, C., 15:37803
Banhart, J., *See* Weinberger, P., 15:37224
Bao, X.J., Incorporation of defects during processing of mercuric iodide detectors, 15:37248 (J;US)
Barber, G.C., *See* Becraft, W.R., 15:37432
See Gouge, M.J., 15:38204
Barbour, J.C., *See* Venturini, E.L., 15:37258
Bard, A.J., Vectorial electron transfer on designed surfaces. Final report, February 1984-December 1989, 15:37291 (R;US)
Bark, R.A., *See* Dracoulis, G.D., 15:37873
See Fabricius, B., 15:37874
Barker, L.E., Estimating the parameters of a sporadically observed queue, 15:38317 (R;US)
Barlett, M., *See* Taddeucci, T.N., 15:37858
Barletta, W.A., A compact x-ray free electron laser, 15:37447 (R;US)
A fast injection system with a superconducting accumulator ring for a tau charm factory, 15:37502 (R;US)
See Hopkins, D.B., 15:37483
Barlow, D., *See* Seth, K.K., 15:37860
Barlow, J.L., An improved method for one-way dissection with singular diagonal blocks, 15:38330 (R;US)
Barna, B.A., *See* Rodriguez, J.G., 15:37394
Barnes, G.W., Alignment of the TFTR bumper limiter, 15:38147 (RA;US)
Barnett, B., *See* Jacobsen, R., 15:37534
Barnett, D.R., An evaluation of carpooling projects at two Missouri rideshare programs, 15:37077 (RA;US)
Barraud, A., *See* Palacin, S., 15:37217
Barreau, G., *See* Boucheneb, N., 15:37892
Barrington, M., *See* Carrera, R., 15:38294
Bars, I., The unitary irreducible representations of SU(2,1), 15:37996 (J;US)
Barsch, G.R., Twin boundaries, interfaces and modulated structures in martensites: Annual progress report No. 5, July 1, 1989–June 30, 1990, 15:37184 (R;US)
Bartlit, J., *See* Anderson, J., 15:38105
Bartlit, J.L., *See* Willms, R.S., 15:38101
Bartlit, J.R., Dispersion and removal of tritium released into the main cell of TSTA, 15:38102 (RA;US)
The ARIES tokamak fusion reactor study, 15:38151 (RA;US)
Basford, J.A., *See* Egert, C.M., 15:37181
Bassiouni, Z.A., Cyclic CO_2 injection for light oil recovery: Performance of a cost shared field test in Louisiana: [Sixth quarterly report], April–June 1990, 15:36724 (R;US)
Basu, A., *See* Bose, M., 15:37204
Basu, S., Coordinated observations of high-latitude ionospheric turbulence, 15:37704 (R;US)
Bateman, C.A., Coarsening kinetics of the tetragonal phase in a manganesia-partially-stabilized zirconia, 15:37257 (J;US)
Bates, J.B., Properties of electrolyte and electrode films prepared by rf and dc magnetron sputtering, 15:37247 (BA;US)
Bates, J.K., *See* Ebert, W.L., 15:36764
Bathke, C.G., Vertical stability requirements for ARIES-1 reactor, 15:38145 (RA;US)
See Bartlit, J.R., 15:38151
See Peng, Y.K.M., 15:38014
Batte, G.L., Run - Beyond - Cladding - Breach (RBCB) test results for the Integral Fast Reactor (IFR) metallic fuels program, 15:36946 (R;US)
Battle, P.D., A study of a new incommensurate phase in the system $SrMn_{1-x}Co_xO_{3-y}$, 15:37167 (J;US)
Batzer, T., *See* Walthers, C., 15:38135
Bauer, T.H., Quantitative studies of severe fuel damage using delayed neutron data, 15:36938 (R;US)
See Doerner, R.C., 15:36953
See Kramer, J.M., 15:36959
See Rhodes, E.A., 15:36954
Baughman, R.J., *See* Ginley, D.S., 15:37261
See Venturini, E.L., 15:37258
Baumgart, C.W., Curve fitting and error modeling for the digitization process near the Nyquist rate, 15:37402 (R;US)
Baxi, C., *See* Gallix, R., 15:38128
Baxi, C.B., Thermal design and analysis of DIII-D advanced divertor, 15:38133 (RA;US)
See Smith, J.P., 15:38211
Baxter, A.M., *See* Fabricius, B., 15:37874
Bayes, D.V., COMPASS electrical systems and commissioning, 15:38112 (RA;US)
Bayhurst, G., *See* Golf, F., 15:36864
Bayless, J.R., *See* Hopkins, D.B., 15:37483
Bayley, S.E., Sandia Sorption Data Management System, Version 2 (SSDMS II): User's manual, 15:36788 (R;US)
Baylor, L.R., The control system for the multiple-pellet injector on the Joint European Torus, 15:38245 (RA;US)
See Combs, S.K., 15:38225
See Gouge, M.J., 15:38204
See Schmidt, G.L., 15:38255
Bean, R.M., *See* Cataldo, D.A., 15:37687
Beatty, R.L., *See* Cooper, R.H., 15:37043
Beausang, C.W., *See* Becker, J.A., 15:37882
See Stephens, F.S., 15:37883
Beauvais, G., Propagation in an adsorbing porous medium of a mixture of anionic and non-ionic surfactants, 15:36725 (R;FR;In French)
Beavis, D., *See* Winger, J.A., 15:37861
Beck, K.M., Vibrational relaxation of highly excited SiF_4 and C_6F_5H by Ar, 15:37352 (J;US)
Becker, H., *See* Ballinger, R., 15:38219
Becker, J.A., Level spin and moments of inertia in superdeformed nuclei near A = 194, 15:37882 (R;US)
See Stephens, F.S., 15:37883
Beckman, R.J., Sampling plans to find faulty waste storage drums, 15:37377 (R;US)
Beckstead, J.A., Magnetic flux generation and sawteeth in the MST reversed-field pinch, 15:38285 (BA;US)
Becraft, W.R., High energy (1-2 MeV) beams for magnetic fusion - tokamak plasma heating and current drive, 15:37432 (RA;US)
See Stirling, W.L., 15:38239
Beecraft, W.R., *See* Bartlit, J.R., 15:38151
Beene, J.R., [Understanding the variety of nuclear excitations]: Foreign trip report, May 19–26 1990, 15:37838 (R;US)
See Auble, R.L., 15:37889
See Bertrand, F.E., 15:37880
See Morsch, H.P., 15:37877
See Nicolis, N.G., 15:37871
See Sarantites, D.G., 15:37865
Beguin, D., Wind heating feasibility, 15:36877 (R;FR;In French)
Behravesh, M.M., *See* Avioli, M.J. Jr., 15:36934
Beise, E., *See* Burger, W.J., 15:37866
Bell, G.L., *See* Rasmussen, D.A., 15:38062
Bell, H.H., *See* Lang, D.D., 15:38165

Bell, J.D., *See* Rasmussen, D.A., 15:38062
Bell, P., *See* Kania, D.R., 15:37308
Bellan, P.M., *See* Brown, M.R., 15:38090
Belotti, E., *See* Maier-Reiter, W., 15:37681
Bender, C.M., Hot δ expansion, 15:37822 (J;US)
Bender, M.A., Testing methodologies, 15:37663 (R;US)
Benenson, D.M., *See* Sen, U., 15:38059
Benfatto, I., The RFX energy transfer units, 15:38221 (RA;US)
Benford, J., *See* Levine, J.S., 15:38068
Bengtson, R.D., *See* Rasmussen, D.A., 15:38062
Bennett, B.L., *See* Cooke, D.W., 15:37259
Bennett, J.D., *See* Morman, J.A., 15:36916
Bennett, L.F., *See* Smith, D.L., 15:37458
Bennett, P.C., *See* Reaves, K., 15:37383
Bensinger, J.R., *See* Kirsch, L.E., 15:37753
Berg, J.D., *See* Lee, R.S., 15:37553
Bergan, N.E., Studies of thermodynamic non-ideality effects on chemical equilibrium and oxidation reactions in supercritical fluids, 15:36741 (BA;US)
Berger, J.F., Microscopic study of the ^{238}U-^{238}U system and anomalous pair production, 15:37888 (J;US)
Berggren, R.G., *See* Nanstad, R.K., 15:37393
Bergin, W., *See* Camp, R.A., 15:38109
Bergman, L.B., *See* Modine, F.A., 15:37252
Berman, F., *See* Mattson, J.S. Jr., 15:38336
Bernhardt, A.F., Process margins for laser planarization of 1 to 5 μm gold films, 15:37958 (BA;US)
Berry, J.L., *See* Abou Yehia, H., 15:36951
Berry, L., The market penetration of energy-efficiency programs, 15:37037 (R;US)
Berry, L.A., *See* Tsai, C.C., 15:37716
Berry, M., Management research, 15:38309 (R;FR;In French)
Berry, W.B., *See* Mrig, L., 15:36840
Berthier, J., *See* Bohl, W.R., 15:36926
Bertho, C., Contribution to the study of low temperature pyrolysis of Gardanne coal, 15:36698 (R;FR;In French)
Bertozzi, W., *See* Kelly, J.J., 15:37857
Bertrand, F.E., Excitation and photon decay of giant multipole resonances, 15:37880 (R;US)
See Auble, R.L., 15:37889
See Morsch, H.P., 15:37877
Besnard, D.C., Spectral transport model for turbulence, 15:37739 (R;US)
Bester, N.L., *See* Rufo, M.W., 15:37100
Beuhler, R.J., Beuhler, Friedman, and Friedlander reply, 15:37849 (J;US)
Bevilacqua, G., *See* Baker, W.R., 15:38113, 15:38139
Bhadra, D.K., Assessment of possible high-energy neutral beam injection in DIII-D, 15:38010 (RA;US)
Bhatia, S.C., *See* Walker, G.A., 15:37593
Bhatia, T.S., *See* Glass, G., 15:37786
Bhowmik, A., *See* Barletta, W.A., 15:37447
Bhushan, B., *See* Dugger, M.T., 15:37241
Bickerton, R., *See* Carrera, R., 15:38294
Bickley, A.J., Beamline duct gas release conditioning and the upgraded duct wall protection system of the JET neutral injection, 15:38253 (RA;US)
Biebel, O., Calibration simulation. A calibration Monte-Carlo program for the OPAL jet chamber, 15:37511 (R;DE;In German)
Bieg, K.W., A laser-produced lithium ion source for pulsed-power inertial confinement fusion, 15:38261 (R;US)
See Woodworth, J.R., 15:38283
Bienvenu, G., *See* Boussoukaya, M., 15:37427
Bigelow, C.E., *See* Farnsworth, R.K., 15:36787
Bigelow, T.S., *See* Rasmussen, D.A., 15:38062
Billen, J.H., *See* Schrage, D., 15:37431
Billone, M.C., Advancements in the behavioral modeling of fuel elements and related structures, 15:36997 (BA;US)
See Pahl, R.G., 15:36924
Biney, P.O., A mass transport model for hydrogen generation during lithium-lead/water interactions, 15:38172 (RA;US)
Birnbaum, I., Using commercials to sell DSM programs: A measurement of customer response, 15:37076 (RA;US)
Bisello, D., *See* Augustin, J.E., 15:37764
Bishop, A.R., *See* Balakrishnan, R., 15:37961
See Falo, F., 15:37984
See Schmeltzer, D., 15:37973
Bisognano, J.J., Impedance and wakefields beyond cutoff, 15:37450 (RA;US)
Requirements for longitudinal HOM damping in superconducting recirculating linacs, 15:37469 (RA;US)
Bisson, C.L., *See* Wolfer, W.G., 15:37319
Bistrilich, J.A., *See* Bosshard, A., 15:37784
Bjornholm, T., Superconductivity and oxygen ordering in $(Ca,Ba,La)Cu_3O_{7-\delta}$, 15:37276 (J;US)
Blachot, J., *See* , 15:37894
See Lleres, A., 15:37894
Black, J.K., *See* Mischke, R.E., 15:37526
Black, K., *See* Amann, J.F., 15:37773
Black, W.M., *See* Gold, S.H., 15:38279
Blanchard, J.P., *See* Emmert, G.A., 15:38163
See Santarius, J.F., 15:38155
Blankenbecler, R., *See* Atwood, W., 15:38334
Blankenship, J.L., *See* Auble, R.L., 15:37889
Blann, M., Models and theory for precompound angular distributions, 15:37909 (R;US)
See Scobel, W., 15:37863
Blanpied, G., *See* Seth, K.K., 15:37860
Blanpied, G.S., *See* Burger, W.J., 15:37866
Blanquet, S., The direction of the laboratories, 15:38342 (R;FR;In French)
Blasnik, M., Attrition bias in fuel savings evaluations of low-income energy conservation programs, 15:37078 (RA;US)
Blasse, G., An anti-stokes vibronic line in the emission spectrum of LaF_3:Gd, 15:37176 (J;US)
Blatchley, C.C., Dating of lithic artifacts by counting radon-produced particle tracks. Phase 1. Final report, 15:37688 (R;US)
Blaylock, G.T., *See* Adler, J., 15:37783
Blem, C.J., Advanced binary geothermal power plants: Limits of performance, 15:36868 (R;US)
Blocker, C.A., *See* Kirsch, L.E., 15:37753
Blomgren, J., *See* Hakansson, A., 15:37859
Bloomquist, D.D., *See* Leeper, R.J., 15:38040
Blue, T.E., An accelerator neutron source for BNCT [Boron Neutron Capture Therapy]: Progress report, 15 July 1989–15 March 1990, 15:37644 (R;US)
Bluen, H., A micro-fabrication compatible wiggler design scalable to sub-millimeter periods, 15:38282 (BA;US)
Boatner, L.A., *See* Christen, D.K., 15:37228
Bobbs, B., *See* Barletta, W.A., 15:37447
Boecker, W.D., Synthesis of high purity sinterable silicon carbide powder: Final report, 15:37237 (R;US)
Boer, M., X-ray observations of gamma-ray burst sources, 15:37692 (R;DE)
Boes, E.C., *See* Richards, E.H., 15:36835
Bogacz, S.A., Coherent instability limitations of Fermilab's upgrades, 15:37455 (R;US)
Transition crossing with the space charge: The Johnsen and Umstaetter effects, 15:37456 (R;US)
Bogen, K.T., *See* McKone, T.E., 15:37623
Bogorinski, P., Application of the finite-element program NAMMU for a model of a radioactive waste repository site, 15:36765 (R;DE;In German)
Bohl, W.R., The AFDM [advanced fluid dynamics model] program: Scope and significance, 15:36926 (R;US)
Bolme, G., *See* Schrage, D., 15:37431
Bolt, H.H., *See* Niemer, K.A., 15:38148
Bolton, R.D., *See* Amann, J.F., 15:37773
See Mischke, R.E., 15:37526
Bolton, T., *See* Adler, J., 15:37783
Bonche, P., *See* Berger, J.F., 15:37888
Bondiotte, E.A., Descriptions of research sites in the integrated forest study on effects of atmospheric deposition, 15:37678 (R;US)
Bonetti, R., *See* Blann, M., 15:37909
See Scobel, W., 15:37863
Bonino, C., *See* Rhodes, B.A., 15:37647
Bonnelle, J.P., *See* Houssenbay, S., 15:37215

Bonner, B.P., Anomalous pressure dependence of optical reflectivity in the superconductor $Ba_{0.6}K_{0.4}BiO_3$, 15:37278 (J;US)
See Nagy, P.B., 15:37963
See Radousky, H.B., 15:37275
Bonsignore, P.V., *See* Jody, B.J., 15:37142
Bontemps, A., Dynamic tests of wind turbine metallic blades (Lamboley process), 15:36875 (R;FR;In French)
Bonvicini, G., An inclusive and exclusive algorithm for QED evolution, 15:37798 (J;US)
See Alexander, J., 15:37799
Booth, D., *See* Carrera, R., 15:38294
Booth, J.A., *See* Newton, A.A., 15:38157
See Smith, R.T.C., 15:38117
Booth, W.D., Experimental program and diagnostics for IGNITEX, 15:38015 (RA;US)
See Carrera, R., 15:38207
See Eways, S.E., 15:38009
Boring, A.M., *See* Weinberger, P., 15:37224
Bortoletto, D., Exclusive and inclusive decays of *B* mesons into D_s mesons, 15:37781 (J;US)
Bortolotti, A., Microsources of intense fusion in focused discharges of plasma focus, 15:38299 (BA;US)
Boschi, A., Risk evaluation of the in-vessel plant area of a net type tokamak machine: Direct, induced and common cause failures, 15:38169 (RA;US)
Bose, M., A comparative study of $V_6O_{13.27}$ and V_6O_{13}, 15:37204 (J;US)
Boshoven, J.K., *See* Kim, Jinchoon, 15:38118
Bosia, G., *See* Pain, M., 15:38167
Boss, B.R., *See* Naus, D.J., 15:36995
Bosshard, A., Polarized-target asymmetry in pion-proton bremsstrahlung at 298 MeV, 15:37784 (J;US)
Bottcher, G.C., *See* Pindzola, M.S., 15:37715
Boucheneb, N., High resolution measurements of mass, energy and nuclear charge correlations for ^{229}Th (n_{th}, f) with the Cosi Fan Tutte spectrometer, 15:37892 (R;FR)
Boulatov, D., *See* Ambjoern, J., 15:37809
Bouldin, C.E., *See* Tan, Z., 15:37260
Bourdin, B., Horizontal vibrations of piles in a centrifuge, 15:37398 (R;FR;In French)
Bourdon, J.C., *See* Boussoukaya, M., 15:37427
Bournakis, A.D., Analysis of weatherization measures in low-income mobile homes, 15:37060 (RA;US)
Bourque, R.F., *See* Haloulakos, V.E., 15:38114
Bousfield, D.W., Research on droplet formation for application to kraft black liquors—Final project report: Technical report No. 5, 15:37146 (R;US)
Boussoukaya, M., Electron sources, 15:37712 (R;FR)
LAL contributions to the 1st EPAC conference, 15:37427 (R;FR)
Bowen, B.M., Los Alamos climatology, 15:37570 (R;US)
Bowers, D.A., *See* Mantz, H.C., 15:38132
Bowman, A.W., A rapid response air quality analysis system for use in projects having stringent quality assurance requirements, 15:37592 (J;US)
Boyd, R.N., *See* Sale, K.E., 15:37856
Boyer, J.S., *See* Rao, I.M., 15:37642
Brack, J.T., *See* Clausen, B.L., 15:37854
Bradbury, M., *See* Spitzmiller, D., 15:37637
Bradley, D.K., *See* Delettrez, J., 15:38306
Braid, T.H., *See* Bauer, T.H., 15:36938
Braithwait, S.D., *See* Smith, B.A., 15:37071
Brake, M.L., *See* Gilgenbach, R.M., 15:38072
See Junck, K.L., 15:38080
See Miller, J.D., 15:38281
Bramlette, T.T., *See* Keller, J.O., 15:37397
Brand, H.R., Properties of confined states in phase dynamics, 15:37747 (J;US)
Brandis, P., The persistence of energy savings over time: Two and three years after participation in a retrofit program, 15:37092 (RA;US)
Brandt, C.A., Basalt Waste Isolation Project exploratory shaft site: Final reclamation report, 15:37601 (R;US)
Brant, S., *See* Meyer, R.A., 15:37914
Brault, L., The measurability, by means of the DELPHI detector, of the Z^0 mass and width from the $e^+e^- \rightarrow \mu^+\mu^-\gamma_1...\gamma_n$ (muons) reaction, 15:37774 (R;FR;In French)
Braun, R.L., *See* Burnham, A.K., 15:36739
Braunstein, M.R., *See* Clausen, B.L., 15:37854
Braylan, R.C., *See* Salzman, G.C., 15:37640
Bredemeier, M., Influence of reductions in deposition on the degree of acidification of soils and groundwater in forests - assessment of critical loads from the atmosphere. Final report, 15:37622 (R;DE;In German)
Breiland, W.G., *See* Ho, P., 15:37239
Brennan, T.M., *See* Vawter, G.A., 15:37418
Breuer, H., *See* Burger, W.J., 15:37866
Breun, R.A., *See* Brouchous, D., 15:38087
Brewe, D.L., *See* Tan, Z., 15:37260
Brower, J.H., *See* Sternlieb, B.J., 15:37268
Brezinsky, K., *See* Linteris, G.T., 15:37372
Brient, J., *See* Adler, J., 15:37783
Brimblecombe, P., *See* Clegg, S.L., 15:36825
Brinker, C.J., *See* Frye, G.G., 15:37238
Brinkerhoff, J.R., Arsenal of democracy in the face of change: Issues underlying the implementation of industrial mobilization policy: Working paper No. 3, 15:37548 (R;US)
Brinkschulte, H., *See* Pain, M., 15:38167
Brixner, L.H., *See* Blasse, G., 15:37176
Brogan, J.D., *See* Cashwell, J.W., 15:36763
Bromberg, L., *See* Sze, D.K., 15:38153
Bronner, G., *See* Hatcher, R.E., 15:38191
See Neumeyer, C., 15:38189
Brooker, R.G., Testing the effectiveness of a residential rebate program by tracking sales of appliances inside and outside the utility's territory: The case of Wisconsin Electric's 1988 Smart Money Program, 15:37084 (RA;US)
Brooks, A.W., Structural analysis of the toroidal field coils for the Compact Ignition Tokamak (CIT), 15:38218 (RA;US)
Brooks, E.D. III, A scalable coherent cache system with incomplete directory state, 15:38339 (R;US)
Brooks, E.D. III., A scalable coherent cache system with fuzzy directory state, 15:38337 (R;US)
Brouchous, D., Radial ion diffusion induced by cyclotron resonance heating at the thermal barrier region in the Phaedrus-B Tandem Mirror, 15:38087 (BA;US)
Brow, R.K., *See* Osborne, Z.A., 15:37292
Browder, T.E., *See* Adler, J., 15:37783
Brower, K.L., Electron paramagnetic resonance and capacitance-voltage studies of ultraviolet irradiated Si-SiO_2 interfaces, 15:37309 (J;US)
Brown, B., *See* Thorne, B.J., 15:37399
Brown, C.H. Jr., *See* Hall, R., 15:36774
Brown, D.W., *See* Duchane, D.V., 15:36870
See Robinson, B.A., 15:36860
Brown, J., Naval Petroleum Reserve No. 3, Naval Oil Shale Reserves Nos. 1, 2, 3: Site environmental report, CY 1989, 15:37564 (R;US)
Brown, J.S., *See* Adler, J., 15:37783
Brown, K.A., Combined nitrogen oxides/sulfur dioxide control in a spray-dryer/fabric-filter system: Summary report for the Field Research Program, 15:36895 (R;US)
Brown, M.A., Promoting the commercialization of energy innovations: An evaluation of the energy-related inventions program, 15:37053 (RA;US)
Brown, M.D., *See* Butner, D.N., 15:38053
Brown, M.R., Current drive by spheromak injection into a tokamak, 15:38090 (J;US)
Brown, R.D., *See* Cooke, D.W., 15:37259
Brown, R.G., *See* Butler, W.H., 15:37987
Brown, T., *See* Grisham, L.R., 15:38149
Brown, T.G., *See* Spampinato, P.T., 15:38159
Brun-Yaba, C., Performance assessment of alpha wastes disposal in deep geological formations, PACOMA project: granite option, 15:36768 (R;FR;In French)
See Lewi, J., 15:36769
Brunsell, P., Plasma position from ring current measurements in Extrap T1, 15:38045 (R;SE)

Brusati, M., *See* Pain, M., 15:38167
Brust, F.W., *See* Leis, B.N., 15:36747
Bruynseraede, Y., *See* Bjornholm, T., 15:37276
Bryant, D.A., Two theories of auroral electron acceleration, 15:37705 (R;GB)
Bryant, H.C., *See* Quick, C.R., 15:37415
Bryant, T.C., *See* Reda, D.C., 15:36881
Bryman, D., Recent results from rare kaon decay experiments, 15:37779 (R;CA)
Brynestad, J., *See* Williams, R.K., 15:37355
Brzosko, J.S., *See* Bortolotti, A., 15:38299
Brzozowski, J.H., Impurity behaviour in the EXTRAP-T1 pinch experiment studied by VUV spectroscopy, 15:38048 (R;SE)
Buchau, J., *See* Basu, S., 15:37704
Buckner, S.W., *See* Gord, J.R., 15:37328
Budal, J.D., *See* Christen, D.K., 15:37228
See Norton, D.P., 15:37249
Budd, P., *See* Rhodes, B.A., 15:37646, 15:37647
Budnick, J.I., *See* Tan, Z., 15:37260
Buende, R., ITER [International Thermonuclear Experimental Reactor] guide for reliability analysis, 15:38108 (RA;US)
Buescher, B.J., *See* Wolfram, J.H., 15:36992
Bule, M.J., *See* Pindzola, M.S., 15:37715
Bunch, J.M., *See* Vigil, A.S., 15:37550
Bungaard-Jorgensen, U., *See* Hopper, R.J., 15:36745
Bunnell, K.O., *See* Adler, J., 15:37783
Buon, J., A stochastic model of depolarization enhancement due to large energy spread in electron storage rings, 15:37457 (R;FR)
Burch, J., *See* Subbarao, K., 15:37132
Burchat, P., *See* Jacobsen, R., 15:37534
Burchell, M., *See* Adler, J., 15:37783
Burchfield, L.A., *See* Hembree, D.M., 15:38007
Burgdoerfer, J., *See* Mueller, J., 15:37933, 15:37943
Burge, R., *See* Levy, C.D.P., 15:37500
Burger, W.J., Reaction ^{58}Ni(π^+,*pp*) at T_{π^+}=160 MeV, 15:37866 (J;US)
Burgeson, I.E., Mechanism and applicability of hydrolysis of peptides and proteins utilizing Pt(II) complexes, 15:37521 (R;US)
Burgess, C.P., Supersymmetry breaking with vanishing cosmological constant in string theory, 15:37816 (J;US)
Burgman, H.A., *See* Kim, H.J., 15:36711
Burke, A.F., *See* MacDowall, R.D., 15:37157
Burkhardt, H., Application of the absorption of seismic waves in hydrocarbon exploration, 15:36719 (R;DE)
Burleson, G., *See* Seth, K.K., 15:37860
Burley, B.L., DIII-D F-coil chopper selection, control and fault recognition system, 15:38229 (RA;US)
Burnett, T.H., *See* Adler, J., 15:37783
Burnham, A.K., Comparison of isothermal and nonisothermal pyroylsis data with various rate mechanisms: Implications for kerogen structure, 15:36739 (J;US)
Burtis, C.A., [Automation and new technology]: Foreign trip report, August 31, 1988–September 12, 1988, 15:38326 (R;US)
Burtner, G., *See* Dobeck, N., 15:37468
Burton, J.W., Effective one-loop scalar Lagrangian in no-scale supergravity models, 15:37999 (J;US)
Bury, R.B., *See* Esque, T.C., 15:37595
Bush, H., *See* Gettelfinger, G., 15:38185
Bushnell, C.W., *See* Vieira, R., 15:38095
Buskulic, D., The search of the top quark in the UA2' experiment, 15:37770 (R;FR;In French)
Butl, T.N., *See* Kelly, J.J., 15:37857
Butler, W.H., Multiple scattering theory for space filling potentials, 15:37987 (R;US)
Butner, D.N., MTX [Microwave Tokamak Experiment] data acquisition and analysis computer network: Revision 1, 15:38053 (R;US)
Buttram, M.T., *See* Harjes, H.C., 15:37411
See Rinehart, L.F., 15:37408
Byrd, R.C., *See* Blann, M., 15:37909
See Scobel, W., 15:37863
See Taddeucci, T.N., 15:37858
Byrne, A.P., *See* Dracoulis, G.D., 15:37875

C

Cabrera, B., *See* Young, B.A., 15:37317
Cada, G.F., *See* Hunsaker, D.B. Jr., 15:36901
Cadwallader, L.C., Identification and selection of initiating events for experimental fusion facilities, 15:38168 (RA;US)
Caffee, M.W., *See* Felton, J.S., 15:37653
Cahalan, J., Performance of metal and oxide fuels during accidents in a large liquid metal cooled reactor, 15:36955 (R;US)
Cahalan, J.E., Modeling developments for the SAS4A and SASSYS computer codes, 15:36921 (R;US)
Cai, M., *See* Edwards, B.F., 15:37967
Caird, R.S., *See* Lindemuth, I.R., 15:38307
Calabrese, A., *See* Harrison, F.L., 15:37682
Calame, J., Realization of cavity and drift space designs for a 30 MW, 10 GHz gyroklystron, 15:38069 (BA;US)
See Lawson, W., 15:37481
Callaway, J., *See* Lee, A., 15:37056
Callin, R.S., *See* Allen, M.A., 15:37475, 15:37501
Callis, R.W., *See* Kim, Jinchoon, 15:38118
Camargo, S.J., Self-similar statistics in MHD turbulence, 15:38026 (R;DE)
Cambi, G., *See* Boschi, A., 15:38169
Cammarata, R.C., Nanoindentation study of the mechanical properties of copper-nickel multilayered thin films, 15:37205 (J;US)
Camp, R.A., TFTR CAMAC power supplies reliability, 15:38109 (RA;US)
Campa, A., Fast sound in binary fluid mixtures, 15:37966 (J;US)
Campagne, J.E., Electromagnetic radiative corrections at LEP-SLC energies for experimentalists, 15:37775 (R;FR)
Study of the muonic channel of $e^+e^- \rightarrow \mu^+\mu^-$ (γ) for the DELPHI experiment: radiative corrections and performance of trigger and reconstruction systems, 15:37776 (R;FR;In French)
Campbell, A.W., *See* Hunsaker, D.B. Jr., 15:36901
Campbell, B., *See* Schrage, D., 15:37431
Campbell, E.M., Nova experiments, 15:38266 (RA;US)
Campbell, J.H., Development of composite polymer-glass edge claddings for Nova Laser Disks, 15:37413 (BA;US)
See Kozlowski, M.R., 15:38273
See Wolfe, C.R., 15:37304, 15:38272
Campbell, R.G., *See* Adams, M.B., 15:37609
Campion, A., *See* Bard, A.J., 15:37291
Campostrini, P.P., Electromagnetic compatibility of the machine measuring equipment in RFX experiment, 15:38230 (RA;US)
Canadell, E., *See* Wang, E., 15:37164
Cano-Yelo, H., Photo-oxidation and photo-reduction of the ruthenium complex tris (2,2'bipyridine) in an organic medium. Applications to photoelectrochemical cells and photoinduced redox catalysis, 15:36830 (R;FR;In French)
Cantor, R., Sources and consequences of hypothetical bias in economic analyses of risk behavior: Draft, 15:37009 (R;US)
Canty, M.J., *See* Avenhaus, R., 15:36810
Cao, Yu, *See* Walker, G.A., 15:37593
Carangelo, R.M., *See* Solomon, P.R., 15:36716
Carboneau, M.L., *See* Modro, S.M., 15:36971
Carey, T.A., *See* Alde, D.M., 15:37782
See Taddeucci, T.N., 15:37858
Cargulia, G., *See* Brooks, A.W., 15:38218
See Dahlgren, F., 15:38186
Carius, S., *See* Amann, J.F., 15:37773
See Mischke, R.E., 15:37526
Carjan, N., Classical model for α-particle emission during nuclear fission, 15:37891 (R;FR)
Carlsmith, R., *See* Hirst, E., 15:37030
Carlson, A.L., *See* Leeper, R.J., 15:38040
Carlson, O.N., *See* Axtell, S.C., 15:37210
Carlson, R.V., *See* Bartlit, J.R., 15:38102
Carmel, Y., *See* Calame, J., 15:38069
Carnahan, B., Bilateral agreements providing negative security assurances to states party to the Nuclear Non-Proliferation Treaty, 15:37161 (R;US)
Constitutional implications of implementing a chemical weapons convention, 15:37559 (R;US)
Carnes, S.A., *See* Rogers, G.O., 15:37560

Caron, P.R., Incision of damaged versus nondamaged DNA by the Escherichia coli UvrABC proteins, 15:37639 (J;US)
Carr, M.J., The EISI [Elemental and Interplanar Spacing Index] index—A search/match tool for electron diffraction phase analysis, 15:38347 (R;US)
Carrera, R., IGNITEX experiment, 15:38294 (BA;US)
Preliminary estimate of the cost breakdown for the fusion ignition experiment IGNITEX, 15:38207 (RA;US)
See Booth, W.D., 15:38015
See Dong, J.Q., 15:38008
See Eways, S.E., 15:38009
See Miller, G.A., 15:38215
See Montalvo, E., 15:38011, 15:38116, 15:38193
See Ordonez, C.A., 15:38130
See Palmrose, D.E., 15:38295
Carreras, B.A., Effect of the equilibrium magnetic field on plasma edge fluctuations, 15:38016 (R;US)
Effect of the radial electric field on turbulence, 15:38018 (R;US)
Resistive MHD turbulence, 15:38019 (R;US)
See Rasmussen, D.A., 15:38062
Carretta, R., *See* Baker, W.R., 15:38113
Carriere, J.P., *See* Guesnier, B., 15:37006
Carroll, D.F., Technique for tensile creep testing of ceramics, 15:37253 (J;US)
Carson, J.M., *See* Kozub, T.A., 15:38209
Carter, J.C. III, Prevention of early containment failure due to high pressure melt ejection and direct containment heating for advanced light water reactors: Advanced Reactor Severe Accident Program, 15:36965 (R;US)
Carter, K.R., *See* Rasmussen, D.A., 15:38062
Carter, R.J., Human factors issues associated with advanced instrumentation and controls technologies in nuclear plants, 15:36939 (R;US)
Carter, W.C., *See* Ceder, G., 15:37263
Carty, R.H., Experimental and theoretical investigation of the formation and growth of ash agglomerates: Final report, 15:36693 (R;US)
Cascales, C., *See* Salvador, P., 15:37168
Casey, C., *See* Gehrke, R.J., 15:37879
Cashwell, C.E., Transportation accidents/incidents involving radioactive materials, (1971–1989), 15:36807 (R;US)
Cashwell, J.W., StateGEN/StateNET and DOT guidelines: Tools for highway routing of hazardous materials, 15:36763 (R;US)
Casper, T., MTX [Microwave Tokamak Experiment] diagnostics and timing system for FEL [free electron laser] heating experiments: Revision 1, 15:38276 (R;US)
Casper, T.A., *See* Butner, D.N., 15:38053
Casperson, D.E., Prospect of multiphoton induced inner shell excitations for x-ray laser pumping, 15:38296 (BA;US)
Castaneda, O., *See* Goff, S., 15:36863
Castleman, A.W. Jr., *See* Stanley, R.J., 15:37337
Castro, A., The π, K, proton electromagnetic form factors and new related DM2 results, 15:37768 (R;FR)
Cataldo, D.A., An evaluation of the environmental fate and behavior of munitions materiel (TNT, RDX) in soil and plant systems: Environmental fate and behavior of TNT [trinitrotoluene]: Final report, 15:37687 (R;US)
Catford, W.N., Study of ^{19}N and ^{21}O by multinucleon transfer, 15:37850 (R;AU)
Caughman, J.B.O. II, An assessment of the lifetime of Faraday shield elements, 15:38129 (RA;US)
Cauvin, R., *See* Olivera, J.J., 15:36910
Cavallone, G., *See* Boschi, A., 15:38169
Cavin, O.B., *See* Wolf, J.S., 15:37183
Cecchini, A., Assembly procedures and thermal and mechanical performances during the commissioning phase of the FTU machine, 15:38124 (RA;US)
Cecil, F.E., Comment on "Cluster-impact fusion", 15:37848 (J;US)
Ceder, G., Phase diagram and low-temperature behavior of oxygen ordering in $YBa_2Cu_3O_z$ using *ab initio* interactions, 15:37263 (J;US)
Cenerino, G., *See* Adroguer, B., 15:36909
Cernansky, N.P., *See* Wilk, R.D., 15:36740
Cernes, A., *See* Brun-Yaba, C., 15:36768
See Escalier des Orres, P. Devillers, 15:36770
See Lewi, J., 15:36769
Chadwick, R.B., *See* Leyba, J.D., 15:37887
Chakoumakos, B.C., *See* Thompson, J.R., 15:37976
Challis, C.D., *See* Bickley, A.J., 15:38253
Chamberland, B.L., *See* Tan, Z., 15:37260
Chamberlin, J.H., *See* Herman, P., 15:37094
Chamberlin, J.L., *See* Richards, E.H., 15:36835
Chambers, D., *See* Karr, T., 15:37742
Champion, R.L., *See* Huels, M.A., 15:37731
Chan, C., *See* Morgan, M.A., 15:38278
Chan, J.K., *See* Di Domenico, P., 15:36969
Chan, K.T., Growth studies of pseudomorphic GaAs/InGaAs/AlGaAs modulation-doped field-effect transistor structures, 15:37311 (J;US)
Chance, C.M., *See* McBee, M.R., 15:36818
Chandler, G., *See* Leeper, R.J., 15:38040
Chang, C.L., *See* Friedman, A., 15:38067
Chang, C.P., Magnetic susceptibility of californium fluorides, 15:37325 (J;US)
Chang, Hsiangpin, Selective electrocatalysis of anodic oxygen-transfer reactions at chemically modified, thin-film lead dioxide electrodes, 15:37235 (R;US)
Chang, Shih-Ger, *See* Littlejohn, D., 15:36900
Chang, T.N., *See* Tang, X., 15:37735
Chang, Y., Formation of $In_xGa_{1-x}As/GaAs$ heteroepitaxial layers using a pulsed laser driven rapid melt-solidification process, 15:37310 (J;US)
Chang, Y.W., *See* Hill, D.J., 15:36956
See Kuroda, T., 15:36958
See Livolant, M., 15:36996
Chant, N.S., *See* Burger, W.J., 15:37866
Chapman, O.J.V., *See* Balkey, K.R., 15:36943
Chapman, R.N., The synthesis of solar radiation data for sizing stand-alone photovoltaic systems, 15:36844 (R;US)
Charboneau, B.L., *See* Leeper, S.A., 15:37151
Chartas, G., *See* Beckstead, J.A., 15:38285
Charvet, J.L., *See* Morsch, H.P., 15:37877
Chase, L.L., *See* Powell, R.C., 15:37324
Chaudhury, A., *See* Kaczarowski, R., 15:37878
Chavez, J.M., Results of the design and testing of a porous ceramic absorber for a volumetric air receiver, 15:36846 (R;US)
Chaza, C., *See* Chavez, J.M., 15:36846
Chehab, R., Positron sources, 15:37711 (R;FR)
Study of a positron source generated by photons from ultrarelativistic channeled particles, 15:37710 (R;FR)
Chen Shuming, *See* Zheng Hualing, 15:37367
Chen, Bai-Hao, Phase transitions in CsCl-type intemetallic compounds, 15:37190 (R;US)
Chen, C., Soliton switch using birefringent optical fibers, 15:37540 (J;US)
Chen, C.H., Stability of laser-induced retained austenite in ductile iron, 15:37200 (BA;US)
Chen, G., Hardware development and initial subassembly test of a gas-fired Stirling/Rankine residential heat pump, 15:37145 (R;US)
Chen, H.C., Theoretical study of stability analysis for relativistic planar magnetron, 15:38300 (BA;US)
Chen, Hudong, *See* Chen, Shiyi, 15:37740
Chen, J.C., *See* Greene, G.A., 15:37392
Chen, J.G., *See* Shi, D., 15:37267
Chen, J.L.S., *See* Kim, H.J., 15:36711
Chen, M.H., Effects of autoionizing resonances on electron-impact excitation rates for transitions among n=3 levels in neonlike selenium, 15:37725 (J;US)
Chen, P.J., *See* Siddiqui, H.R., 15:37366
Chen, Pisin, *See* Yokoya, Kaoru, 15:37461
Chen, S.L., An investigation to define the physical/chemical constraints which limit NO_x emission reduction achievable by reburning: Final report, 15:36708 (R;US)
Chen, S.P., *See* Hack, J.E., 15:37208
Chen, Shiyi, A lattice gas model for thermohydrodynamics, 15:37740 (R;US)
Chen, W.H., *See* Shi, D., 15:37250

Chen, Y., *See* Carrera, R., 15:38294
Cheng, A.Y., *See* Bao, X.J., 15:37248
Cheng, E.T., Activation evaluation of fusion solid breeder materials, 15:38171 (RA;US)
See Wong, C.P.C., 15:38154
Cheng, J., Enhanced ordering and stability of Pd_8W in proton irradiated Pd-W alloys, 15:37206 (J;US)
Cheng, S.C., Microcomputer based program for predicting heat transfer under reactor accident conditions. Volume I: Text, 15:36913 (R;CA)
Cheong, S.W., *See* McCarty, K.F., 15:37242
Chernin, D., Design constraints for e^+-e^- supercolliders at energies of 0.5-2.0 TeV per linac, 15:37439 (RA;US)
See Granatstein, V.L., 15:37474
Chetti, M.B., High-temperature sensitivity and its acclimation for photosynthetic electron reactions of desert succulents, 15:37673 (J;US)
Chiang, C.J., *See* Dirks, J.A., 15:36848
See Richards, E.H., 15:36836, 15:36837
Chien, P.L., *See* Solomon, P.R., 15:36716
Chiesa, C., *See* Blann, M., 15:37909
Chisholm, M.F., *See* Pennycook, S.J., 15:37281, 15:37941
Choi, S.I., *See* Modine, F.A., 15:37252
Chong, S.L., Characteristics of pyrobitumen and oil obtained from the pyrolysis of Tipton member Green River oil shale, 15:36756 (J;US)
Chornack, M.P., *See* Diehl, S.F., 15:37690
Chou, S.Y., *See* Chang, Y., 15:37310
Christen, D.K., Large, orientation-dependent enhancements of critical currents in $Y_1Ba_2Cu_3O_{7-x}$ epitaxial thin films: Evidence for intrinsic flux pinning?, 15:37228 (R;US)
See Norton, D.P., 15:37249
See Thompson, J.R., 15:37976
Christensen, U., A code for calculating force and temperature of a bitter plate type toroidal field coil system, 15:38176 (RA;US)
Chu, T.Y., Developing convection above a finite horizontal surface, 15:37388 (R;US)
Chu, Y.T., *See* Bates, J.B., 15:37247
Chung, Y.W., *See* Dugger, M.T., 15:37241
Church, E.L., Instrumental effects in surface finish measurement, 15:37537 (R;US)
See Takacs, P.Z., 15:37280
Cialone, H.J., Investigation of sulfide-stress cracking at pipe seam welds, 15:36748 (R;US)
Ciangaru, G., *See* Burger, W.J., 15:37866
Cipolli, R., *See* Cooper, C.V., 15:37202
Ciskowski, D.E., *See* Taddeucci, T.N., 15:37858
Citrolo, J.C., *See* Pusateri, J.A., 15:38217
Clapp, R.B., *See* Hoeksema, R.J., 15:37627
Clark, B.F., *See* Bieg, K.W., 15:38261
Clark, N.N., A study of coal particle shape and three-body wear: Quarterly report, January 1990–March 1990, 15:36704 (R;US)
Clark, P.C., *See* Sharifi, M.R., 15:37611
Clark, R.S., *See* Rinehart, L.F., 15:37408
Clark, W., *See* Schrage, D., 15:37431
Clarke, J., *See* Johnson, M., 15:37423
See Wellstood, F.C., 15:37420
Clausen, B.L., Analysis of pion scattering to stretched states in ^{60}Ni and other nuclei using Woods-Saxon wave functions, 15:37854 (J;US)
Clauser, M.J., *See* Prestwich, K.R., 15:38262
Clayton, C.E., *See* Williams, R., 15:38056
Clegg, S.L., Solubility of ammonia in pure aqueous and multicomponent solutions, 15:36825 (J;US)
Clemmer, R., *See* Anderson, J., 15:38105
Cline, D.B., *See* Barletta, W.A., 15:37447
Clinton, J.M., High efficiency fluorescent lighting program: An experiment with marketing techniques to reach commercial and small industrial customers, 15:37061 (RA;US)
Clinton, T.W., *See* Zhang, H., 15:37277
Close, F.E., *See* Zhenping Li, 15:37790
Coates, B., *See* Sumi, D.H., 15:37091
Coburn, L.L, Petroleum industry restructuring: The influence of tax and antitrust policies, 15:36734 (BA;US)
Coburn, L.L., Alternative transportation fuels: A tax and energy perspective, 15:36824 (BA;US)
Coburn, T.T., *See* Burnham, A.K., 15:36739
Cody, B., Estimation of the incremental cost of constructing super good cents homes: Methodology and results, 15:37112 (RA;US)
Coffey, H.E., Solar-Geophysical Data Number 546, February 1990. Part 1 (prompt reports). data for January 1990, December 1989, and late data, 15:37693 (R;US)
Solar-Geophysical Data Number 546, February 1990. Part 2 (comprehensive reports). Data for August 1989 and miscellaneous, 15:37694 (R;US)
Cohen, E.G.D., *See* Campa, A., 15:37966
Cohen, H.D., *See* Graham, C., 15:37683, 15:37684
Cohen, L., *See* Moreno, J.C., 15:37414
Cohen, S.A., *See* Redi, M.H., 15:38035
Colchin, R.J., *See* Rasmussen, D.A., 15:38062
Cole, J.A., *See* Chen, S.L., 15:36708
Cole, J.D., A Recoil Mass Spectrometer for the HHIRF [Holifield Heavy Ion Research Facility] facility, 15:37518 (R;US)
Coleman, L.W., Laser program overview, 15:38264 (RA;US)
Coleman, M.M., *See* Painter, P.C., 15:37320
Colleraine, A., *See* Hong, R., 15:38142
Collins, G.W., *See* Mapoles, E.R., 15:37974
Collins, J.L., *See* Osborne, M.F., 15:36944
Colson, W.B., Theoretical simulations of the synchrotron instability in high gain, high power free electron lasers: Final report, 15:37460 (R;US)
Coltrin, M.E., *See* Ho, P., 15:37239
Comans, R.M.J., Reversibility of interaction of cesium with clay minerals, mud suspensions, and sediments of Dutch surface water bottom: Final report cesium project by request of DBW/RIZA, 15:37602 (R;NL;In Dutch)
Combs, K.E.S., *See* Ziemniak, S.E., 15:37236
Combs, S.K., Operation and reliability of a pneumatic hydrogen pellet injection system on the Joint European Torus, 15:38225 (RA;US)
See Gouge, M.J., 15:38197, 15:38204
Comfort, J.R., *See* Glover, C.W., 15:37855
Connell, J.R., The wind lumps that bump a rotor, 15:36885 (BA;US)
Connor, K.A., *See* Resnick, J., 15:38082
See Schwelberger, J., 15:38073
Contolini, R.J., *See* Bernhardt, A.F., 15:37958
Cook, R.B., Sulfur cycling and fluxes in temperate dimictic lakes, 15:37613 (R;US)
Cooke, D., *See* Morgan, M.A., 15:38278
Cooke, D.W., Neutron-induced microwave loss in ceramic $YBa_2Cu_3O_{7-\delta}$, 15:37259 (J;US)
Cooksey, N., *See* Levine, J.S., 15:38068
Coon, D.N., Vitreous joining of SiC fiber reinforced SiC composites, 15:37284 (R;US)
Cooper, C.V., Deposition and adhesion of PECVD boron coatings on Ti-6Al-4V substrates, 15:37202 (BA;US)
Cooper, G., *See* Leeper, R.J., 15:38040
Cooper, M.D., *See* Amann, J.F., 15:37773
See Mischke, R.E., 15:37526
Cooper, R.H., Operational readiness review plan for the radioisotope thermoelectric generator materials production tasks, 15:37043 (R;US)
Cooper, R.H. Jr., [Nuclear power engineering in space]: Foreign trip report, May 11, 1990–June 3, 1990, 15:36932 (R;US)
Cooper, W.S., *See* Grisham, L.R., 15:38149
See Purgalis, P., 15:38238
Coradini, M.L., *See* Biney, P.O., 15:38172
Corcuera, R.P., Designing an AI-environment prototype for the automatic startup of EBR-II [Experimental Breeder Reactor-II], 15:36941 (R;US)
Coriano, C., Singularity of Green's function and effective action in massive Yang-Mills theories, 15:37820 (J;US)
Corley, J.P., *See* Prestwich, K.R., 15:38262
Cormier, T.M., *See* Cole, J.D., 15:37518
Corn, P.B., *See* Sale, K.E., 15:37856
Cornelius, A.L., *See* Shi, D., 15:37267
Cornelius, W.D., *See* Tallerico, P.J., 15:37473
Cornett, K.D., Mechanical properties of silica coatings, 15:37226 (R;US)

Corsberg, D., *See* Di Domenico, P., 15:36969
Cosme, G., *See* Augustin, J.E., 15:37764, 15:37765
Couchot, F., *See* Augustin, J.E., 15:37764, 15:37765
See Chehab, R., 15:37710
Couher, M.E., *See* Cooper, C.V., 15:37202
Counce, D., *See* Adams, A., 15:36862
See Golf, F., 15:36864
Counce, R.M., *See* Wilson, J.H., 15:37612
Courbion, G., *See* Hemon, A., 15:37173, 15:37174
Court, J., *See* Bontemps, A., 15:36875
Cousot, P., Data processing, 15:38318 (R;FR;In French)
Cover, R.A., *See* Barletta, W.A., 15:37447
Cowgill, M.G., *See* Pescatore, C., 15:36766
Cowles, S., *See* Kercher, J.R., 15:37586
Cox, J.P., Surface water resources issues analysis: Wheeler Reservoir watershed region, 15:37621 (R;US)
Crabb, J.A., An approach to the design of energy efficient heated buildings, 15:37129 (R;GB)
Crabtree, G.W., *See* Kwok, W.K., 15:37986
Cram, L.S., *See* Spitzmiller, D., 15:37637
Cramer, P., *See* Karr, T., 15:37742
Cramer, S.N., Investigation of radiation effects in Hiroshima and Nagasaki using a general Monte Carlo-discrete ordinates coupling scheme, 15:37932 (R;US)
Crancon, J., *See* Lieres, A., 15:37894
Crandall, G.C., *See* White, D.S., 15:37052
Crandall, R.S., Direct measurement of the mobility-lifetime product of holes and electrons in an amorphous silicon p-i-n cell, 15:36839 (BA;US)
See Tsuo, Y.S., 15:36841
Crandell, R.S., Defect relaxation in disordered materials: Stretched exponentials, Meyer-Neldel rule, and Staebler-Wronski effect, 15:37305 (BA;US)
Crawford, D., Maintaining optimum light output with a thermally conductive heat pipe, 15:37120 (R;US)
Crawford, O.H., [Symposium on dynamic particle-condensed matter interactions]: Foreign trip report, November 28, 1988–December 9, 1988, 15:37950 (R;US)
Crawford, R.W., *See* Oh, M.S., 15:36757
Crawley, P.J., *See* Hayward, R.J., 15:38115
Creedon, R.L., *See* Sze, D.K., 15:38153
See Wong, C.P.C., 15:38154
Crespin, S., *See* Bontemps, A., 15:36875
Crim, F.F., *See* Sinha, A., 15:37354
Crisanti, F., Active plasma position and current feedback control in the FTU tokamak machine, 15:38127 (RA;US)
Croesmann, C.D., *See* Niemer, K.A., 15:38148
Croessmann, C.D., *See* Niemer, K.A., 15:38292
Crommie, M.F., Thermal conductivity of single-crystal Bi-Sr-Ca-Cu-O, 15:37272 (J;US)
Crossland, R.T., *See* Hayward, R.J., 15:38115
Crouch-Baker, S., Composite polyphase electrochemical cell components, 15:37003 (BA;US)
Crowe, K.M., *See* Bosshard, A., 15:37784
Crowley, T.P., *See* Resnick, J., 15:38082
See Schwelberger, J., 15:38073
Crume, E.C., *See* Rasmussen, D.A., 15:38062
Cumming, J.B., *See* Winger, J.A., 15:37861
Cuneo, M.E., *See* Bieg, K.W., 15:38261
See Gilgenbach, R.M., 15:38072
Cussler, E.L., *See* Baker, R.W., 15:37147, 15:37148
Czerwinski, K.R., *See* Leyba, J.D., 15:37887

D

D'hondt, P., *See* Maerker, R.E., 15:36912
D'Onofrio, A., *See* Auble, R.L., 15:37889
See Kim, H.J., 15:37869
Dagang, D.A., Evaluation of Bonneville's commercial audit program, 15:37087 (RA;US)
Dagenhart, W.K., *See* Becraft, W.R., 15:37432
Daghighian, F., PET imaging: An overview and instrumentation, 15:37654 (J;US)
Dahlbacka, G.H., *See* Filbert, P.C., 15:38076
Dahlberg, J.An., *See* Ronsten, G., 15:36878
Dahlburg, J.P., Ablative Rayleigh-Taylor instability in three dimensions, 15:38093 (J;US)
Dahlgren, F., TFTR TF coil thermal analysis and test, 15:38186 (RA;US)
See Gettelfinger, G., 15:38185
Dai, P., *See* Zhang, Y., 15:37316
Dairaku, M., *See* Kuriyama, M., 15:38144
Dale, M.C., Comparison of ethanol recovery processes from an immobilized cell reactor-separator, 15:37144 (R;US)
Scale-up and performance of an immobilized cell reactor separator for the production of ethanol from whey lactose, 15:36821 (R;US)
Dale, V.H., Report of a workshop on using remote sensing to estimate land use change, 15:37600 (R;US)
Dalgarno, A., *See* Hahn, Y., 15:37727
Daminelli, G.B., *See* Martinis, L., 15:38198
Dandoloff, R., *See* Balakrishnan, R., 15:37961
Daniels, E.J., *See* Jody, B.J., 15:36887, 15:37142
Danson, C.N., Oscillator and system development on the VULCAN glass laser system for the plasma beat-wave program, 15:37444 (R;GB)
Daoudi, M., Study of the all neutral final state of $f_2(1270)$ produced in two-photon collisions as a background to radiative neutrino counting on the Z^0 resonance, 15:37801 (J;US)
Darwin, R.F., *See* Weakley, S.A., 15:37127
Das, A., Propagators for shape-invariant potentials, 15:38000 (J;US)
Dasgupta, A., *See* Whang, S.H., 15:37245
Datta, A., Evidence for cluster sites on catalytic alumina, 15:37213 (J;US)
Dauncey, P., *See* Jacobsen, R., 15:37534
Davenport, J.W., *See* Wang, Y.J., 15:37724
Davey, C.B., *See* Adams, M.B., 15:37609
David, S.A., Weldability of iron aluminides, 15:36691 (R;US)
Davidson, J.H., Experimental study of a self-pumping boiling collector solar hot water system, 15:36858 (J;US)
Davies, J.F., *See* Bickley, A.J., 15:38253
Davies, K.T.R., Dispersion relations for causal Green's functions: Derivations using the Poincare–Bertrand theorem and its generalizations, 15:37994 (J;US)
Davies, P.B., *See* Fawzy, W.M., 15:37338
Davies, R.W., *See* Davies, K.T.R., 15:37994
Davies-White, W.A., Parameters and requirements for the B Factory vacuum chamber, 15:37507 (R;US)
Davis, J., *See* Phelps, T.J., 15:37626
Davis, R., Serving vital needs: An evaluation of the energy savings for nonprofits program, 15:37088 (RA;US)
See Schueler, V., 15:37107
Davis, R.L., Quantum turbulence, 15:37744 (J;US)
Davis, T., *See* Birnbaum, I., 15:37076
Davis, W.T., *See* Huang, H., 15:36892
Daw, G., *See* Seth, K.K., 15:37860
Dawson, J.M., *See* Sydora, R.D., 15:38089
See Whittum, D.H., 15:37422
De Armond, M.K., *See* Myrick, M.L., 15:37214
de Esch, H.P.L., *See* Bickley, A.J., 15:38253
de Fontaine, D., *See* Salomons, E., 15:37273
De Groot, A.J., *See* Holian, B.L., 15:37396
De Groot, J.S., *See* Mizuno, K., 15:38057, 15:38256
De Lorenzi, A., The RFX pulse transmission network, 15:38205 (RA;US)
de Saussure, G., *See* Derrien, H., 15:37885
Dean, E.M., *See* Rhodes, W.D., 15:36923
Dean, R.S., *See* Foley, W.J., 15:36979
Dearborn, D.S., *See* Alcock, C.R., 15:37804
Dearien, J.A., Multimegawatt space power reactors, 15:36925 (R;US)
Dearstone, K.C., *See* Hoeksema, R.J., 15:37627
Debord, J., *See* Guesnier, B., 15:37006
Debschuetz, W., *See* Burkhardt, H., 15:36719
Dec, J.E., *See* Keller, J.O., 15:37397
Decman, D.J., Atomic electron binding energies of multiply charged krypton ions by internal-conversion-electron spectroscopy, 15:37723 (J;US)
Degen, B.D., *See* Fox, J.M., 15:36697

Dehaven, R., *See* Levy, C.D.P., 15:37500
Deissler, R.J., *See* Brand, H.R., 15:37747
Deitrich, L.W., *See* Hill, D.J., 15:36956
Del Buono, L., Data acquisition system realization for H1 experiment, 15:37527 (R;FR;In French)
Del Gandio, P., The use of Computer Aided Management of Emergency Operations (CAMEO) at the Tokamak Fusion Test Reactor (TFTR), 15:38250 (RA;US)
Delahaye, J.P., Reverse bending magnets in a combined-function lattice for the CLIC (CERN Liner Collider) damping ring, 15:37448 (BA;US)
Delahoy, A.E., *See* Crandall, R.S., 15:36839
Delayen, J.R., Superconducting accelerating structures for high-current ion beams, 15:37466 (RA;US)
Deleide, G., *See* Rhodes, B.A., 15:37647
Delepianque, M.A., *See* Becker, J.A., 15:37882
See Stephens, F.S., 15:37883
Delettrez, J., Effect of barrier layers in burnthrough experiments with 351-nm laser illumination, 15:38306 (J;US)
Dell'Orso, M., Large P_t jets at CDF, 15:37756 (R;US)
Dellin, T.A., *See* Miller, S.L., 15:37424
DeLong, L.E., *See* Kwok, W.K., 15:37986
Demazure, M., Mathematics, 15:37991 (R;FR;In French)
DeMoll, E., The role of purine degradation in methane biosynthesis and energy production in Methanococcus vannielii: Progress report, March 1, 1989–February 28, 1990, 15:37634 (R;US)
Den Hartog, D.J., An energy confinement study of the MST [Madison Symmetric Torus] reversed field pinch using a Thomson scattering diagnostic, 15:38022 (R;US)
See Beckstead, J.A., 15:38285
Dennis, B., Cathodic protection evaluation of well casings using wireline techniques, 15:36727 (RA;CA)
Results of investigations at the Ahuachapan geothermal field, El Salvador: Part 1, Well logging and brine geochemistry, 15:36861 (R;US)
See Adams, A., 15:36862
Derrien, H., Resonance analysis of the ^{239}Pu neutron cross sections in the energy range 300 to 2000 eV, 15:37885 (R;US)
Deruyter, H., *See* Allen, M.A., 15:37475, 15:37501
Derzon, M.S., *See* Leeper, R.J., 15:38040
Deschamps, G.H., *See* Massmann, P., 15:38180
Desjarlais, M.P., *See* Prestwich, K.R., 15:38262
See Slutz, S.A., 15:37464
Dessus, B., Energy, development and environment: planetary stakes in the 21st century, 15:37028 (J;FR;In French)
Destler, W.W., *See* Striffler, C.D., 15:38280
Detai Wang, The development of long pulse high voltage power supply for MNI-$_1$U neutral beam injector, 15:38206 (RA;US)
Dethman, L., Design assistance for new commercial buildings, 15:37101 (RA;US)
DeVan, J.H., Development of surface treatments and alloy modifications for corrosion-resistant oxide scales, 15:36692 (R;US)
See Alexander, D.J., 15:36690
DeVault, G.P., Two-dimensional multiburst calculations with the SHALE code, 15:37551 (R;US)
DeVries, G.E., *See* Purgalis, P., 15:38238
deWit, R., *See* Naus, D.J., 15:36995
Dexin, H., *See* Ronsten, G., 15:36878
Dexter, R.N., *See* Beckstead, J.A., 15:38285
See Lovell, T.W., 15:38284
Dey, A, Radio loud far-infrared galaxies, 15:37695 (R;US)
Di Domenico, P., Alarm Processing System, 15:36969 (R;US)
Diamond, R.M., *See* Becker, J.A., 15:37882
See Stephens, F.S., 15:37883
Diao, J., *See* Fuerstenau, D.W., 15:36705
Diaz, F.A., Trace elements concentrations at San Juan metropolitan area and at El Yunque peak, 15:37589 (BA;US)
Dickerman, C.E., *See* Rhodes, E.A., 15:36954
Dickson, R.E., *See* Hanson, P.J., 15:37656, 15:37657
Diehl, S.F., Stratigraphic correlation and petrography of the bedded tuffs, Yucca Mountain, Nye County, Nevada, 15:37690 (R;US)
Diercks, D.R., *See* Kassner, T.F., 15:36906
Dietrich, D.D., *See* Simionovici, A., 15:37734
Dif, B., Pyrolysis-gasification of biomass. Development of a fluidized bed reactor, 15:36822 (R;FR;In French)
Difilippo, F.C., Workshop on scientific and industrial applications of free electron lasers, 15:37539 (R;US)
[Passive monitoring of nuclear systems]: Foreign trip report, May 18–30, 1988, 15:36940 (R;US)
DiGiola, A.M. Jr., Direct embedment foundation research: Load test summaries: Final report, 15:36998 (R;US)
Dilmanian, F.A., *See* Nicolis, N.G., 15:37871
DiMauro, L.F., *See* Kim, D., 15:37732
See Saeed, M., 15:37417
See Tang, X., 15:37735
Dirks, J.A., Optimizing the value-to cost ratio for central receiver electric power plants, 15:36848 (J;US)
Disalvo, F.J., *See* Vassiliou, J.K., 15:37166
Diver, R.B., Trends in dish-Stirling solar receiver designs, 15:36859 (R;US)
See Andraka, C.E., 15:36847
Dixon, F.P., *See* Barletta, W.A., 15:37447
Dixon, R.K., *See* Hanson, P.J., 15:37656, 15:37657
Doan, T.P., *See* Boucheneb, N., 15:37892
Dobbin, K.D., *See* Padilla, A. Jr., 15:36928
Dobbing, J.A., *See* Pain, M., 15:38167
Dobeck, N., Modular magnet current regulator, 15:37468 (RA;US)
Doebell, M., *See* Bosshard, A., 15:37784
Doemer, R.C., Fuel motions in the multi-pin PFR/TREAT test series, 15:36953 (R;US)
Doenni, A., Structure of the dimer compounds $Cs_3R_2Br_9$ (R = Tb, Dy, Ho, Er, Yb) at 8 and 295 K studied by neutron diffraction, 15:37172 (J;US)
Doige, A.G., Dynamics of the Ross-Stirling engine, 15:37401 (R;CA)
Donahue, D.A., *See* Liu, Y.Y., 15:36961
Donald, M., IR design and parameters of APIARY VI, 15:37454 (R;US)
Dong, J., *See* Carrera, R., 15:38294
See Montalvo, E., 15:38116
Dong, J.Q., Structural eddy current effects on plasma equilibrium and current induction in the IGNITEX experiment, 15:38008 (RA;US)
Donlach, S., *See* Voruganti, P., 15:37983
Donovan, L.A., Response of woody swamp seedlings to flooding and increased water temperatures. I. Growth, biomass, and survivorship, 15:37628 (J;US)
Doolen, G.D., *See* Chen, Shiyi, 15:37740
Dorfman, M., *See* Negus-de Wys, J., 15:36866
Dose, E.V., Effects of extracolumn convolution on preparative chromatographic peak shapes, 15:37330 (R;US)
Doser, M., *See* Bosshard, A., 15:37784
Doss, E.D., Three-dimensional parametric study for MHD marine propulsion, 15:37155 (R;US)
Doughty, D.H., *See* Frye, G.G., 15:37238
Douglas, J.R., *See* Rasnake, D.G., 15:37041
Dovbnya, A.N., *See* Gladkikh, P.I., 15:37435
Dover, C.B., *See* Richard, J.M., 15:37787
Doverspike, L.D., *See* Huels, M.A., 15:37731
Dracoulis, G.D., Conversion coefficients and yrast state spins in ^{180}Os, 15:37875 (R;AU)
Intrinsic states and rotational bands in ^{177}Pt, 15:37873 (R;AU)
See Fabricius, B., 15:37874
Drake, D.M., *See* Hakansson, A., 15:37859
Drake, J.B., [Conference on vector and parallel computing]: Foreign trip report, May 31, 1988–June 14, 1988, 15:38322 (R;US)
Drake, J.R., Experimental studies of equilibrium in the toroidal Extrap T1 experiment, 15:38041 (R;SE)
Drake, R.P., *See* Mizuno, K., 15:38057
Draper, J.E., *See* Becker, J.A., 15:37882
See Stephens, F.S., 15:37883
Drayer, D.D., Redundant and independent containment and surveillance systems, 15:36814 (R;US)
Drebing, C.G., *See* Hughes, R.C., 15:37409
Dreil, P., *See* Alexander, J., 15:37799
Drennan, E., Ampacity test of 28 AWG ribbon cables, 15:37404 (R;US)
Drickamer, H.G., *See* Ley, W.W., 15:37360, 15:37361
Driga, M., *See* Carrera, R., 15:38294
See Montalvo, E., 15:38116

Driga, M.D., *See* Hsieh, K.T., 15:38175
See Werst, M.D., 15:38293
Drlik, M., *See* Butner, D.N., 15:38053
Drobot, A., Verification of product quality from process control, 15:36776 (R;US)
Drobot, A.T., *See* Friedman, A., 15:38067
Drost, M.K., Analysis of air-to-air heat exchanger performance data taken under the Residential Standards Demonstration Program, 15:37128 (R;US)
Drotning, W.D., *See* Allred, R.E., 15:37295
Drozdowicz, K., *See* Hoek, M., 15:37516
Druger, S.D., *See* Ratner, M.A., 15:37299
Drummond, T.J., Application of InAlAs/GaAs superlattice alloys to GaAs solar cells, 15:37296 (R;US)
Dryer, F.L., *See* Linteris, G.T., 15:37372
Duan Yunfu, *See* Zhou Zhihong, 15:37368
Dubrovin, A., *See* Boussoukaya, M., 15:37427
Duchane, D.V., Progress in hot dry rock technology development, 15:36870 (R;US)
Duco, J., Objectives, specification and elaboration of technical scenarios for emergency drills involving a French PWR, 15:36908 (R;FR)
Duda, L.E., Development and field testing of the high-temperature borehole televiewer, 15:37536 (R;US)
Dudek, F.J., *See* Jody, B.J., 15:37142
Dudek, L., *See* McDade, J., 15:38241
Dudley, V., *See* Andraka, C.E., 15:36847
Dudney, C.S., *See* Matthews, T.G., 15:37137
Dudney, N.J., Enhanced ionic conductivity in composite electrolytes, 15:37307 (BA;US)
See Bates, J.B., 15:37247
Duffield, W., *See* Goff, S., 15:36863
Dufournet, F., Adaptation of magnesian cements to underground storage of nuclear wastes, 15:36779 (R;FR;In French)
Dugger, M.T., Wear mechanisms of amorphous carbon and zirconia coatings on rigid disk magnetic recording media, 15:37241 (R;US)
Dumas, M., *See* Thomas, J.B., 15:38314
Duncan, R.V., Thermal effects on the Josephson series-array voltage standard, 15:37412 (R;US)
Dunham, M.E., *See* Baumgart, C.W., 15:37402
Dunn, F.E., Consequences of pipe ruptures in metal fueled, liquid metal cooled reactors, 15:36957 (R;US)
Dunn, L.A., Country statements on the nuclear non-proliferation treaty, Article 6, 15:37160 (R;US)
Duque, R.E., *See* Salzman, G.C., 15:37640
Dutz, H., Construction and test of the Bonn frozen spin target, 15:37465 (R;DE;In German)
Dwyer, H.A., *See* Bergan, N.E., 15:36741
Dyer, F., *See* Alexeff, I., 15:38065
Dyer, F.F., *See* Robinson, L., 15:36945
Dylla, H.F., *See* LaMarche, P.H., 15:38136
See Martin, G.D., 15:38138

E

Early, E.A., *See* Bjornholm, T., 15.37276
See Weir, S.T., 15:37255
Ebbesen, T.W., Role of specific solvation in the fluorescence sensitivity of 1,8-ANS to water, 15:37359 (J;US)
Ebert, W.L., The reaction of glass during gamma irradiation in a saturated tuff environment: Part 4, SRL 165, ATM-1c, and ATM-8 glasses at 1E3 R/h and O R/h, 15:36764 (R;US)
Ebinger, M.H., Long-term fate of depleted uranium at Aberdeen and Yuma Proving Grounds: Final report, Phase 1: Geochemical transport and modeling, 15:36795 (R;US)
Ebisawa, N., *See* Kuriyama, M., 15:38144
Ebisawa, Tooru, Multi-layer film neutron interferometers, 15:37523 (RA;JP;In Japanese)
Echer, C.J., *See* Koestler, C., 15:37209
Ecker, L., *See* Michelsen, L., 15:37072
Ecker, L.K., Comparative analysis of the effect of incentives on weatherization programs, 15:37049 (RA;US)
Eckert, C.A., Supercritical fluid thermodynamics for coal processing: Quarterly progress report, January 1, 1990–March 31, 1990, 15:36695 (R;US)
Eddy, T.L., *See* Shaw, C.B. Jr., 15:37332
Edelstein, A.S., *See* Cammarata, R.C., 15:37205
Edelstein, R., Cost requirements for solar thermal electric and industrial process heat, 15:36857 (BA;US)
Edenburn, M.W., The potential impact of conservation and alternative energy sources on carbon dioxide emissions, 15:37017 (R;US)
Edmonds, J., *See* Scott, M., 15:36710
Edmonds, P.H., *See* Li, G., 15:38302
See Ordonez, C.A., 15:38130
Edstrom, C.M., Fabricating vanadium sheet to improve symmetry of drawn parts, 15:37195 (R;US)
Edwards, B.F., Rate equation and scaling for fragmentation with mass loss, 15:37967 (J;US)
Edwards, G., *See* Campbell, J.H., 15:37413
Efthimion, P.C., *See* Stratton, B.C., 15:38036
See Synakowski, E.J., 15:38034
Egert, C.M., Diffuse absorbing beryllium coatings produced by magnetron sputtering, 15:37182 (R;US)
Vacuum outgassing from diffuse-absorptive baffle materials, 15:37181 (R;US)
Eggen, D.T., *See* Livolant, M., 15:36996
Ehlke, S., *See* Kushler, M., 15:37098
Eidson, A.F., Biological characterization of radiation exposure and dose estimates for inhaled uranium milling effluents: Final report, 15:36803 (R;US)
Eisler, G.R., *See* Feddema, J.T., 15:37382
Ekedahl, A., *See* Pain, M., 15:38167
El Cashlan, A.G., *See* Vahala, L.L., 15:38017
El-Guebaly, L.A., Shielding design options for the TF magnets of ITER (International Thermonuclear Experimental Reactor), 15:38226 (RA;US)
See Emmert, G.A., 15:38163
El-Idrissi Rachidi, I., *See* Wang, E., 15:37164
Elevant, T., *See* Booth, W.D., 15:38015
Ello, F., *See* Baker, W.R., 15:38113, 15:38139
Elliott, M.G., *See* Wilson, J.H., 15:37612
Ellis, S.D., One-jet inclusive cross section at order α_s^3: Quarks and gluons, 15:37802 (J;US)
Emery, J.F., *See* Robinson, L., 15:36945
Emery, K., *See* Tsuo, Y.S., 15:36841
Emmert, G.A., Apollo-L2, an advanced fuel tokamak reactor utilizing direct conversion, 15:38163 (RA;US)
See Santarius, J.F., 15:38155
Enemark, E., *See* Wolfe, C.R., 15:37244
Engelgau, D.E., *See* Leeper, S.A., 15:37151
Engelhard, L., *See* Burkhardt, H., 15:36719
Engelstad, R.L., *See* Sviatoslavsky, I.N., 15:38234
Engi, D., A qualitative architecture for understanding policy responses to global change, 15:37019 (BA;US)
Engkvist, I., *See* Albinsson, Y., 15:37603
Englin, J., *See* Lee, A., 15:37113
Enloe, C.L., *See* Gilgenbach, R.M., 15:38072
Enoeda, M., *See* Anderson, J., 15:38105
See Bartlit, J.R., 15:38102
Enoeda, N., *See* Walthers, C., 15:38135
Eppley, K.R., *See* Allen, M.A., 15:37475, 15:37501
Equer, B., Interfaces and thin films physics, 15:37285 (R;FR;In French)
Erickson, C.M., *See* Cashwell, J.W., 15:36763
Eriksen, T.E., Some notes on diffusion of radionuclides through compacted clays, 15:37604 (R;SE)
Esarey, E., *See* Sprangle, P., 15:38092, 15:38305
Escalier des Orres, P. D, Scenarios used for the evaluations of the safety of a site for adioactive waste disposal in deep geologic formations, 15:36770 (R;FR;In French)
Escher, R.N., *See* Cooper, R.H., 15:37043
Esen, E.B., *See* Obot, N.T., 15:37374
Espinoza, C., *See* Mischke, R.E., 15:37526
Esque, T.C., Distribution, habitat and habits of the desert tortoise (Gopherus agassizii) in the eastern Mojave Desert, 15:37595 (R;US)
Essington, E.H., *See* Ebinger, M.H., 15:36795

Estabrook, K.G., *See* Mizuno, K., 15:38057
Esterowitz, L., Laser-diode-pumped, erbium-doped, solid-state laser with high slope efficiency, 15:37425 (P;US)
Estoque, J., *See* Gordon, H.T., 15:36855
Euringer, H., Neutral injection for TEXTOR, 15:38143 (RA;US)
Evans, K. Jr., *See* Peng, Y.K.M., 15:38014
Evans, L., *See* Pacheco, J., 15:36856
Evans, M., Deformations of conformal field theories and symmetries of the string, 15:37819 (J;US)
Evans, P., Integration of process evaluation and program design, 15:37064 (RA;US)
Evans, W.C., *See* Golf, F., 15:36864
Eveleigh, D.E., Cellulase: A key enzyme for fermentation feedstocks: Progress report, September 1, 1987–August 31, 1988, 15:37631 (R;US)
Cellulase: A key enzyme for fermentation stocks: Final report, 1987–1989, 15:37632 (R;US)
Cellulase: A key enzyme for fermentation stocks: Progress report, 1989–1990, 15:37633 (R;US)
Evrard, J.M., *See* Thomas, J.B., 15:38314
Eways, S., *See* Carrera, R., 15:38294
Eways, S.E., Cavity resonance mode plasma breakdown for the IGNITEX experiment, 15:38009 (RA;US)
Eykamp, W., *See* Baker, R.W., 15:37147, 15:37148
Eylon, S., Beam studies in the L.B.L. MBE-4 device, 15:38297 (BA;US)

F

Fabes, B.D., Mechanical properties of coatings and interfaces, 15:37225 (R;US)
See Cornett, K.D., 15:37226
Fabre, E., The utilization of high-intensity lasers, 15:37403 (R;FR;In French)
Fabricius, B., High spin states and intrinsic structure in ^{174}Os and ^{175}Os -alignments and strong interaction, 15:37874 (R;AU)
See Dracoulis, G.D., 15:37873, 15:37875
Fabry, A., *See* Maerker, R.E., 15:36912
Fache, P., *See* L'Homme, A., 15:36952
Fairfax, S.A., The Alcator C-MOD power system, 15:38190 (RA;US)
Faith, S., *See* Bayley, S.E., 15:36788
Falcone, R.W., *See* Murnane, M.M., 15:37544
Falo, F., *I-V* characteristics in two-dimensional frustrated Josephson-junction arrays, 15:37984 (J;US)
Falter, H.D., *See* Altmann, H., 15:38131
See Massmann, P., 15:38180
Fan Shiguo, *See* Zheng Hualing, 15:37367
Fang, J.M., Some estimates of free rider proportions in demand-side management programs, 15:37080 (RA;US)
Fang, M.M., *See* Shi, D., 15:37267
Fant, K.S., *See* Allen, M.A., 15:37475, 15:37501
Farber, P.S., *See* Huang, H., 15:36892
Farnsworth, R.K., Crucible melts and bench-scale ISV [in situ vitrification] tests on simulated wastes in INEL [Idaho National Engineering Laboratory] soils, 15:36786 (R;US)
Initial tests on in situ vitrification using electrode feeding techniques, 15:36787 (R;US)
Farrell, M.P., Global climate change and human health: Information needs, research priorities, and strategic considerations, 15:37563 (R;US)
Farrow, N.D., *See* Hoeksema, R.J., 15:37627
Fasching, G.E., Three-dimensional capacitance imaging system, 15:36712 (R;US)
Faurl, M., *See* Baker, W.R., 15:38113
Fauvel, R., *See* Walker, G., 15:37400
Fawzy, W.M., Infrared diode laser spectroscopy of the ν_3 fundamental of the CD_3 radical, 15:37338 (J;US)
Fayer, M.J., UNSAT-H Version 2.0: Unsaturated soil water and heat flow model, 15:36784 (R;US)
Feddema, J.T., Integration of model-based and sensor-based control for a two-link flexible robot arm, 15:37382 (R;US)
Fedders, P.A., *See* Souers, P.C., 15:38308
Federici, G., Tritium analysis of a water-cooled solid breeder blanket for ITER, 15:38121 (RA;US)
Feenstra, R., *See* Christen, D.K., 15:37228
Fehling, D.T., *See* Fisher, P.W., 15:38196
See Gouge, M.J., 15:38204
See Qualls, A.L., 15:38208
Felicke, F., *See* Benfatto, I., 15:38221
Feldman, E.E., *See* Ragland, W.A., 15:36963
Felker, B., Microwave transport system for the MTX, 15:38161 (RA;US)
Fell, J., An account of the OECD LOFT [Organization for Economic Cooperation and Development Loss-of-Fluid] Project, 15:36983 (R;US)
Fellin, L., *See* De Lorenzi, A., 15:38205
Fellows, R.J., *See* Cataldo, D.A., 15:37687
Felton, J.S., Accelerator mass spectrometry in the biomedical sciences: Applications in low-exposure biomedical and environmental dosimetry, 15:37653 (R;US)
Feng Shuyi, *See* Geng Yongjian, 15:37664
Feng, J., *See* Vieira, R., 15:38095
Feng, Shechao, Quantum transport in mesoscopic systems: Annual technical report, September 1989–September 1990, 15:37988 (R;US)
Fenstermacher, M., *See* Casper, T., 15:38276
Ferber, M.K., *See* Jenkins, M.G., 15:37229
Ferguson, R.L., *See* Plasil, F., 15:37881
Ferguson, S.W., *See* Felker, B., 15:38161
Ferro, C., *See* Andreani, R., 15:38160
Ferrucci, L., Short RF pulse propagation in a traveling wave structure, 15:37480 (RA;US)
Fessenden, T.J., Research on multiple-beam induction linacs for heavy ion inertial fusion, 15:38303 (BA;US)
Fetizon, M., *See* Lallemand, J.Y., 15:37346
Feyzi, F., *See* Lovell, T.W., 15:38284
Fields, R.J., *See* Naus, D.J., 15:36995
Fierro, J.L.G., *See* Salvador, P., 15:37168
Fifield, L.K., *See* Catford, W.N., 15:37850
Filbert, P.C., Soft x-ray spectra of low-Z gases produced by laser irradiation of a high-pressure supersonic gas jet, 15:38076 (BA;US)
Filipkowski, M.E., *See* Tan, Z., 15:37260
Finch, S.M., Hanford Environmental Dose Reconstruction Project: Monthly report, 15:37579 (R;US)
Fine, H.A., Assessment of the energy conservation potential of active (variable thermal resistance and switchable absorptance) building thermal insulation systems, 15:37124 (R;US)
Fineberg, J., Weakly nonlinear states as propagating fronts in convecting binary mixtures, 15:37391 (J;US)
Finkel, R.C., *See* Felton, J.S., 15:37653
Finn, J.M., *See* Kelly, J.J., 15:37857
Finn, P., *See* Anderson, J., 15:38105
Finney, W.C., Flue gas cleanup technology utilizing energetic electrons: Final report, May 6, 1986–March 5, 1989, 15:36899 (R;US)
Fiore, C.L., Calculation of neutron and γ production and transport for the Alcator C-Mod experiment, 15:38119 (RA;US)
Fishbone, L.G., International safeguards: Accounting for nuclear materials, 15:36809 (R;US)
Fisher, A., *See* Wessel, F.J., 15:38060
Fisher, K., *See* Ballinger, R., 15:38219
Fisher, P.W., Tritium proof-of-principle pellet injector results, 15:38196 (RA;US)
See Gouge, M.J., 15:38197, 15:38204
See Kozub, T.A., 15:38209
See Qualls, A.L., 15:38208
Fisher, R.A., *See* Amato, A., 15:37288, 15:37979, 15:37980
Fisher, W.J., *See* Gordon, H.T., 15:36855
Fisk, Z., *See* McCarty, K.F., 15:37242
Flanagan, C.A., *See* Buende, R., 15:38108
Fleddermann, C.B., *See* West, J.P., 15:37959
Fleetwood, D.M., *See* Landstrass, M.I., 15:37315
Fleming, R.B., Liquid nitrogen cooling for the compact ignition tokamak, 15:38182 (RA;US)
Fletcher, C.D., *See* Ryskamp, J.M., 15:36950
Flickinger, A., Special nuclear material information, security classification guidance. Instruction, 15:36813 (R;US)

Fliermans, C.B., *See* Phelps, T.J., 15:37626
Filflet, A.W., *See* Gold, S.H., 15:38279
Flory, D., *See* Kupschus, P., 15:38203
Fluss, M.J., *See* Radousky, H.B., 15:37275
Flynn, E.R., *See* Overton, W.C. Jr., 15:37406
See van Hulsteyn, D.B., 15:37978
Flytzanis, C., Quantum optics, 15:37187 (R;FR;In French)
Foley, W.J., Closeout of IE Bulletin 84-03: Refueling cavity water seal: Final report, 15:36979 (R;US)
Folkerts, T.J., *See* Bonner, B.P., 15:37278
Fonck, R.J., *See* Paul, S.F., 15:38033
See Stratton, B.C., 15:38036
See Synakowski, E.J., 15:38034
Fontaine, D. de, *See* Ceder, G., 15:37263
Fontana, M.H., *See* Carter, J.C. III, 15:36965
Foote, J., *See* Casper, T., 15:38276
Foote, J.H., *See* Oda, T., 15:38052
Ford, C.E., *See* Corcuera, R.P., 15:36941
Ford, D.H., *See* Tidwell, S.C., 15:37419
Foreman, L.R., *See* Hoffer, J.K., 15:38260
Foreman, W., *See* Amann, J.F., 15:37773
Forsberg, C.W., [Advanced technologies for water-cooled reactors]: Foreign trip report, May 24–June 12, 1988, 15:36985 (R;US)
Fortunato, T., *See* Andreani, R., 15:38160
Foster, C.A., *See* Gouge, M.J., 15:38204
See Tsai, C.C., 15:38195
Foster, C.C., *See* Blann, M., 15:37909
See Glover, C.W., 15:37855
See Scobel, W., 15:37863
See Taddeucci, T.N., 15:37858
Foster, D.L., *See* Pavlovsky, D.A., 15:38235
Foster, D.R., *See* Lissaman, P.B.S., 15:36884
Foster, I., Parallel programming with algorithmic skeletons, 15:38315 (R;US)
Foster, K.G., *See* Oh, M.S., 15:36757
Foster, K.T., Incorporation of an explosive cloud rise code into ARAC's [Atmospheric Release Advisory Capability] ADPIC transport and diffusion model, 15:37588 (R;US)
Foulliac, C., *See* Sabroux, J.C., 15:36865
Fournier, S., *See* Kim, D., 15:37732
See Tang, X., 15:37735
Foust, C.R., *See* Combs, S.K., 15:38225
Fowkes, W.R., *See* Allen, M.A., 15:37475, 15:37501
Fowler, H., Marketing energy of conservation in an environment of abundance, 15:37051 (RA;US)
Fox, J.A., A comparison of direct control and market based policies for controlling emissions, 15:36709 (R;US)
Fox, J.D., *See* Trcka, D.E., 15:37853
Fox, J.M., Slurry reactor design studies: Topical report, Reactor selection criteria, 15:36697 (R;US)
Fox, M.A., *See* Bard, A.J., 15:37291
Fraker, H., *See* Howard, B.D., 15:36852
Francesconi, R.P., *See* Szlyk, P.C., 15:37558
Frank, K.T., *See* Kozub, T.A., 15:38209
Franta, G., Thermal energy distribution in building interiors, 15:36853 (BA;US)
Frattolillo, A., *See* Martinis, L., 15:38198
Frawley, A.D., *See* Trcka, D.E., 15:37853
Freeman, D.H., Derivative spectrophotometry of metalloporphyrins from shale, 15:36722 (J;US)
Frei, H., *See* Graetzel, M., 15:37178
Freis, R.P., *See* Foster, K.T., 15:37588
Freiser, B.S., *See* Gord, J.R., 15:37328, 15:37329
Frekers, D., *See* Kaczarowski, R., 15:37878
Frenkel, D., *See* Meijer, E.J., 15:37365
Frey, R., *See* Alexander, J., 15:37799
Friar, J.L., *See* Naus, H.W.L., 15:37919
Frick, F.A., *See* Campbell, J.H., 15:37413
Friedel, G., *See* Cahalan, J., 15:36955
Friedlander, G., *See* Beuhler, R.J., 15:37849
Friedman, A., Progress in 3D particle-in-cell modeling of heavy ion beam transport in quadrupole focusing channels, 15:38067 (BA;US)
Friedman, L., *See* Beuhler, R.J., 15:37849
Frieman, J.A., Eternal annihilations: New constraints on long-lived particles from big-bang nucleosynthesis, 15:37703 (J;US)
Fripiat, J.J., *See* Lambert, J.F., 15:37177
Fripp, M.L., *See* Bisognano, J.J., 15:37469
Frit, B., *See* Laval, J.P., 15:37171
Fritsch, W., Mechanisms of double excitation in ion-atom collisions at high velocities, 15:37726 (J;US)
See Reinhold, C.O., 15:37729
Froehle, P.H., *See* Morman, J.A., 15:36916
Frois, B., Electron accelerators and nuclear physics, 15:37426 (R;FR)
Frost, C.A., *See* Mazarakis, M.G., 15:37482
Frye, G.G., Sol-gel coating on acoustic wave devices: Thin film characterization and chemical sensor development, 15:37238 (R;US)
Fu Rongchu, Evaluation of radiation dose for radiological impact of airborne effluents of a coal-fired power plant, 15:37562 (R;CN;In Chinese)
Fu, G., *See* Carrera, R., 15:38294
Fuerstenau, D.W., Surface properties of coal and their role in coal beneficiation: Final report, 15:36705 (R;US)
Fujii, T., *See* Loring, M., 15:38252
See Moriyama, S., 15:38236
Fujita, Y., High resolution investigation of giant resonances, 15:37840 (RA;JP)
Fujiwara, M., *See* Tanaka, M., 15:37498
See Yosoi, M., 15:37532
Fukai, H., *See* Walthers, C., 15:38135
Fukuda, Tomokazu, A proposal to study double-Λ hypernuclei and H-dibaryon by using a 4π-type spectrometer, 15:37761 (R;JP)
Fukui, H., *See* Bartlit, J.R., 15:38102
Fukunaga, K., Four nucleon system at intermediate energy, 15:37901 (RA;JP;In Japanese)
Fukuyama, A., *See* Yoshikawa, K., 15:38224
Fulda, F., *See* Augustin, J.E., 15:37764, 15:37765
Fullam, H.T., *See* Van Tuyl, H.H., 15:36815
Fuller, E.L. Jr., *See* Hembree, D.M., 15:38007
Fuller, G.M., *See* Alcock, C.R., 15:37804
Funk, E.G., *See* Kaczarowski, R., 15:37878
Furrer, A., *See* Doenni, A., 15:37172
Furuno, Kohei, In-beam gamma-ray spectroscopy with crystal ball, 15:37531 (RA;JP;In Japanese)
Fuschini, A., *See* Bortolotti, A., 15:38299
Fusco, F.A., Structural changes in fast ion conducting chloride Doped potassium borate glasses, 15:37303 (BA;US)

G

Gaarde, C., *See* Taddeucci, T.N., 15:37858
Gabbard, W.A., *See* Schwenterly, S.W., 15:38140
Gadeberg, M., *See* Combs, S.K., 15:38225
See Kupschus, P., 15:38203
Galliard, M.K., *See* Burton, J.W., 15:37999
Gaio, E., Commissioning tests and simulation result comparison in RFX AC/DC converters, 15:38231 (RA;US)
Gal, A., *See* Richard, J.M., 15:37787
Gale, L.G., *See* Halford, V.E., 15:36778
Gallardo, J., *See* Barletta, W.A., 15:37447
Gallix, R., A radiation-cooled armor tile design for the first wall of ITER (International Thermonuclear Experimental Reactor), 15:38128 (RA;US)
Gammelin, M., *See* Pain, M., 15:38167
Ganapathi, L., *See* Kumar, A., 15:37256
Gannett, C.M., *See* Leyba, J.D., 15:37887
Gao, Y., Growth of Al oxide layers on GaAs (100) by reaction with condensed molecular oxygen, 15:37322 (J;US)
Garcia-Bermudez, G., *See* Sarantites, D.G., 15:37865
Garcon, M., The polarization observables and the short range deuteron structure, 15:37841 (R;FR;In French)
Gardner, J., *See* Goff, S., 15:36863
Gardner, J.H., *See* Dahlburg, J.P., 15:38093
Gardner, J.N., *See* Goff, F., 15:36864
Garg, U., *See* Kaczarowski, R., 15:37878
Garis, N.S., One-speed neutron transport eigenvalues for reflected slabs and spheres, 15:37921 (R;SE)

Garland, R., *See* Robertson, A., 15:36888
Garren, A., *See* Donald, M., 15:37454
Garribba, M., *See* Tanga, A., 15:38012
Garten, C.T., *See* Hunsaker, D.B. Jr., 15:36901
Garvey, G.T., *See* Alde, D.M., 15:37782
Gasparotto, M., *See* Cecchini, A., 15:38124
Gasperin, M., *See* Tronc, E., 15:37165
Gaudreau, M., *See* Winn, P., 15:38097
Gee, J., *See* Drummond, T.J., 15:37296
Gehl, S.M., *See* Avioli, M.J. Jr., 15:36934
Gehring, P.M., *See* Sternlieb, B.J., 15:37268
Gehrke, R.J., Half-life of ^{176}Lu, 15:37879 (J;US)
Geltenbort, P., *See* Boucheneb, N., 15:37892
Gemmell, D.S., *See* Campbell, J.H., 15:37413
Gendreau, K., *See* Padamsee, H., 15:37470
Geng Yongjian, Isolation and radioprotective assays of tissue inhibitory factors, 15:37664 (R;CN;In Chinese)
Geng, C.Q., Leptonic CP violation in leptoquark models, 15:37794 (R;CA)
Genuario, R., *See* Price, D., 15:37556
Gerber, R.A., *See* Woodworth, J.R., 15:38283
Gerdin, G.A., *See* Vahala, L.L., 15:38017
Gerding, T.J., *See* Ebert, W.L., 15:36764
Gerrish, V., Improved yield of high resolution mercuric iodide gamma-ray spectrometers, 15:37517 (R;US)
Gerstein, B.C., *See* Shao, W., 15:37326
Gervais, H.P., Quantum chemistry and scientific calculus, 15:37342 (R;FR;In French)
Gettelfinger, G., Oil as an alternative coolant for use in the TFTR toroidal field coils, 15:38185 (RA;US)
Getty, W.D., *See* Junck, K.L., 15:38080
Ghanbari, C.M., Redirector design for testing surfaces of revolution at central receiver facilities, 15:36849 (J;US)
Gheesling, S.E., [Control of radiation sources]: Foreign trip report, September 24–October 2, 1988, 15:37016 (R;US)
Ghiron, C.A., *See* Ebbesen, T.W., 15:37359
Ghoneim, N.M., *See* Santarius, J.F., 15:38155
Ghoniem, N.M., *See* Sharafat, S., 15:38216
See Wong, C.P.C., 15:38154
Ghose, J., *See* Padmanaban, N., 15:37169
Giannetti, P., The dijet invariant mass at the Tevatron Collider, 15:37755 (R;US)
Gibb, T.C., *See* Battle, P.D., 15:37167
Gibbon, P., *See* Davis, R., 15:37088
Gibbs, S., *See* Schrage, D., 15:37431
Gibillisco, G.J., *See* Kozub, T.A., 15:38209
Gibson, B.F., Lectures from the workshop on nucleon-nucleon bremsstrahlung, January 25–26, 1990, 15:37763 (R;US)
See Afnan, I.R., 15:37918
Gidaspow, D., Predictive models for circulating fluidized bed combustors: Three dimensional code: Second technical progress report, 15:36713 (R;US)
Giel, T.V., *See* Winkleman, B.C., 15:37040
Gilad, S., *See* Burger, W.J., 15:37866
Gilbert, J.D., *See* Walton, G.R., 15:38249
Gilbon, D., *See* Olivera, J.J., 15:36910
Gilgenbach, R.M., Characterization of the time-evolution of a microsecond electron beam diode with anode effects, 15:38072 (BA;US)
See Miller, J.D., 15:38281
Gillette, J.L., International competitiveness of clean coal technologies, 15:36717 (R;US)
Gilli, R., Filtered containment venting systems for Swiss LWR's - proposed design requirements and principles, 15:36976 (RA;US)
Gilligan, J., Modelling of the vapor shield mechanism during high heat flux ablation of surfaces, 15:38277 (BA;US)
Gilligan, J.G., *See* Niemer, K.A., 15:38148, 15:38292
Gilmore, D.L., *See* Kumar, A., 15:36842
Gim, B.M., *See* Campbell, J.H., 15:37413
Ginley, D.S., Rapid thermal processing of $YBa_2Cu_3O_7$ spun wires, 15:37261 (J;US)
See Venturini, E.L., 15:37258
Ginn, W.C., *See* Andraka, C.E., 15:36847
Girault, P., *See* Boussoukaya, M., 15:37427
Gizon, A., *See* Lieres, A., 15:37894
Gizon, J., Influence of neutron and proton alignments on the shape of A = 120-130 transitional nuclei, 15:37870 (R;FR)
Gladkikh, P.I., Electron beam monochromatization in the linac used as an injector to the stretcher, 15:37435 (RA;US)
Gladney, E.S., *See* Ebinger, M.H., 15:36795
Glaser, R.R., *See* Miknis, F.P., 15:36758
Glass, G., Analyzing power measurement for forward angle *n-p* scattering at 790 MeV, 15:37786 (J;US)
Glass, R.S., *See* Radousky, H.B., 15:37275
Gledhill, B.L., *See* Felton, J.S., 15:37653
Glimm, J., Chaotic mixing as a renormalization-group fixed point, 15:37743 (J;US)
Glish, G.L., *See* Van Berkel, G.J., 15:36721
Glover, C.W., Scattering of polarized protons from ^{6}Li at 200 MeV, 15:37855 (J;US)
Glowka, D.A., Evaluation of a potential borehole televiewer technique for characterizing lost circulation zones, 15:36871 (R;US)
Gnesotto, F., *See* Baker, W.R., 15:38113, 15:38139
Goblet, P., *See* Brun-Yaba, C., 15:36768
Goennenwein, F., *See* Boucheneb, N., 15:37892
Goett, A.A., *See* Clinton, J.M., 15:37061
Goff, F., *See* Dennis, B., 15:36861
See Goff, S., 15:36863
Goff, S., Tecuamburro Volcano, Guatemala geothermal gradient core hole drilling, operations, and preliminary results, 15:36863 (R;US)
Goforth, J.H., *See* Lindemuth, I.R., 15:38307
Goggin, M.E., Quantum logistic map, 15:38005 (J;US)
Gohar, Y., Shielding options for the ITER conceptual design, 15:38213 (RA;US)
See Attaya, H., 15:38187
Goins, M.L., Preliminary design of the CIT cryostat, 15:38183 (RA;US)
Gold, S.H., Initial tests of a 10 MW, 35 GHz phase-locked gyrotron oscillator driven by a pulseline accelerator, 15:38279 (BA;US)
Goldberg, M., *See* Bortoletto, D., 15:37781
Goldberg, M.L., Shooting with a moving camera: Trends in commercial buildings energy consumption, 1979 through 1986, 15:37097 (RA;US)
Goldman, C., *See* Hirst, E., 15:37033
Goldman, T., *See* Maltman, K., 15:37917
See Nieto, M.M., 15:37992
Goldsmith, S., *See* Moreno, J.C., 15:37414
Golec, C.G., *See* Sparks, C.J., 15:37180
Golf, F., The "Art" of in situ fluid sampling and the remarkable compositional variations in the wellbore fluid of VC-2B, Valles Caldera, New Mexico, 15:36864 (R;US)
See Adams, A., 15:36862
Golubev, V., *See* Jacobsen, R., 15:37534
Golubovic, L., Thermal fluctuations and phase equilibrium in microemulsions, 15:37746 (J;US)
Gomez del Campo, J., [Heavy-ion nuclear reactions]: Foreign trip report, June 10, 1988–August 2, 1988, 15:37899 (R;US)
See Kim, H.J., 15:37869
Gomez, T., *See* Ballard, E.O., 15:38111
Gonzales, R.P., *See* Wolfe, C.R., 15:38272
Gonzalez, D.A., Onsite environmental report for the Nevada Test Site, January 1988–December 1988, 15:37567 (R;US)
Gonzalez, R.C., *See* Sweeney, F.J., 15:37375
Goodman, C.D., *See* Taddeucci, T.N., 15:37858
Goodman, J.A., The experimental search for point sources above 1 TeV, 15:37699 (J;US)
Goodwin, J.E., Overcoming intrinsic and synchrotron depolarizing resonances with a Siberian snake, 15:37463 (J;US)
Gorbatkin, S.M., *See* Tsai, C.C., 15:37716
Gord, J.R., Gas-phase photoinduced reactivity of $RhC_5H_6^+$ with cyclopentane, 15:37328 (J;US)
Gas-phase photoinduced reactivity of Co_2NO^+ with O_2 via a photoisomerization mechanism, 15:37329 (J;US)
Gordon, H.T., Nonresidential buildings, 15:36855 (BA;US)
Gordon, R.J., *See* Beck, K.M., 15:37352
See Robie, D.C., 15:37363
Gore, B.F., *See* Balkey, K.R., 15:36943
Gormezano, C., *See* Pain, M., 15:38167
Gorski, A.J., *See* Harkness, J.B.L., 15:36894

Gottardi, M., *See* Boer, M., 15:37692
Gouge, M.J., The CIT pellet injection system: Description and supporting research and development, 15:38197 (RA;US)
The ORNL (Oak Ridge National Laboratory) plasma fueling program, 15:38204 (RA;US)
See Fisher, P.W., 15:38196
See Qualls, A.L., 15:38208
Goulding, C.A., *See* Taddeucci, T.N., 15:37858
Gourlan, C., *See* Andreani, R., 15:38160
Grabemann, I., Transport processes of suspended matter derived from time series in a tidal estuary, 15:37597 (R;DE)
Graener, H., Vibrational population lifetimes of polyalkenes in liquid solution, 15:37356 (J;US)
Graetzel, M., Evidence for hole injection from $O_2(^1\Delta)$ into p-Si, 15:37178 (J;US)
Graf, J., Modelling of the transport of air pollution in orographic regions like Northeast Bavaria, 15:37584 (R;DE;In German)
See Painter, P.C., 15:37320
Graham, C., Immunological and biochemical effects of 60-Hz electric and magnetic fields in humans: Phase 3: Quarterly report No. 6, January 1–March 31, 1987, 15:37683 (R;US)
Immunological and biochemical effects of 60-Hz electric and magnetic fields in humans: Phase 3, Quarterly report No. 9, October 1–December 31, 1987, 15:37684 (R;US)
Graham, G., Air breakdown in the relativistic limit, 15:38078 (BA;US)
Graham, R.L., *See* Hunsaker, D.B. Jr., 15:36901
Granatstein, V.L., A review of Gyroklystrons and a cost estimate for a Gyroklystron-driven supercollider, 15:37474 (RA;US)
See Calame, J., 15:38069
Grandin, J.P., *See* Simionovici, A., 15:37734
Grant, C.W., Depth buffer shadow algorithms, 15:38338 (R;US)
Gratta, G., *See* Jacobsen, R., 15:37534
Graves, C.C., Regulatory analysis for the resolution of generic issue C—8, main steam isolation valve leakage and LCS [leakage control system] failure, 15:36905 (R;US)
Gravina, S., *See* Nettel, S.J., 15:37269
Gray, D., Chemical and biodesulfurization systems for removal of organic sulfur from coal: A critical review, 15:36702 (R;US)
Gray, E.R., *See* Cooke, D.W., 15:37259
See Tallerico, P.J., 15:37473
Gray, K.E., *See* Kim, D.H., 15:37279
Greegor, R.B., *See* Lytle, F.W., 15:37221
Green, D., SDC at high luminosity, 15:37520 (R;US)
Green, R.A., *See* Hart, A.T., 15:37039
Greenbaum, E., [Biotechnology and photosynthesis]: Foreign trip report, June 28–July 14, 1988, 15:36833 (R;US)
Greenberg, J.S., *See* Henderson, S.D., 15:37825
Greenblatt, M., *See* Wang, E., 15:37164
Greene, D.L., Alternative Motor Fuel Use Model: Model theory and design and user's guide, 15:37159 (R;US)
Greene, G.A., Heat transfer between stratified liquids with bubbling across the interface, 15:37392 (R;US)
Greenlee, H.B., *See* Ohl, K.E., 15:37785
Greenly, J.B., *See* Adler, L.K., 15:38085
Greenspan, E., Liquid metal mist cooling and MHD Ericsson cycle for fusion energy conversion, 15:38122 (RA;US)
See Santarius, J.F., 15:38155
Gregorich, K.E., *See* Leyba, J.D., 15:37887
Gregory, D.C., [Atomic and molecular data for metallic impurities in fusion plasmas]: Foreign trip report, May 15–21, 1990, 15:38031 (R;US)
See Pindzola, M.S., 15:37715
Gregory, J.M., Durability of fuel savings for single-family households: Ohio Home Weatherization Assistance Program (HWAP) program years 1985 and 1986, 15:37058 (RA;US)
Gregory, W.S., EXPAC [EXPlosion Analysis Code] user's manual: A computer code for analyzing explosion-induced flow and material transport in nuclear facilities, 15:36802 (R;US)
Gresillon, D., The physics of the ionized media, 15:38025 (R;FR;In French)
Grest, G.S., *See* Li, Q., 15:37975
Griem, H., *See* Moreno, J.C., 15:37414
Griem, H.R., *See* Young, F.C., 15:38301
Griffin, D.C., *See* Pindzola, M.S., 15:37715
Grimblot, J., *See* Houssenbay, S., 15:37215
Grimes, S.M., *See* Anderson, J.D., 15:37920
See Blann, M., 15:37909
Grimsrud, D.T., *See* Turk, B.H., 15:37591
Grisham, L.R., Assessment of possible implications of a neutral beam configuration for CIT, 15:38149 (RA;US)
Groeneveld, D.C., *See* Cheng, S.C., 15:36913
Groom, D.E., Radiation levels in SSC [Superconducting Super Collider] calorimetry, 15:37535 (R;US)
Grosdidier, G., *See* Augustin, J.E., 15:37764, 15:37765
Gross, F., Relativistic effects in low-energy nucleon-nucleon scattering, 15:37910 (J;US)
Grossman, J.M., Numerical and theoretical developments in plasma erosion opening switch research, 15:38287 (BA;US)
Grossman, L., *See* Caron, P.R., 15:37639
Grotz, S.P., *See* Wong, C.P.C., 15:38154
Gubernatis, J.E., *See* Loh, E.Y. Jr., 15:38006
Gubler, R., *See* Gilli, R., 15:36976
Guedel, H.U., *See* Doenni, A., 15:37172
Guesnier, B., Follow-up of the regional energy conservation politics. Methods and illustration with the case of Charente-Poitou, 15:37006 (R;FR;In French)
Guiochon, G., *See* Dose, E.V., 15:37330
Gully, J, *See* Carrera, R., 15:38294
Gully, J.H., *See* Carrera, R., 15:38207
Gunasekaran, M., Microbial liquefaction of peat for the production of synthetic fuels: Final progress report, 15:36694 (R;US)
Guo, X., *See* Siddiqui, H.R., 15:37366
Gutman, S., *See* Chen, Shiyi, 15:37740
Gutowski, W.J., Simulating climate with two different numerical schemes, 15:37565 (R;US)
Guzik, T.G., Current and future uses of accelerators in particle astrophysics, 15:37698 (J;US)
Guzowski, R.V., Preliminary identification of scenarios that may affect the escape and transport of radionuclides from the Waste Isolation Pilot Plant, southeastern New Mexico, 15:36789 (R;US)

H

Haas, H., *See* Thorstenson, D.C., 15:36771
Haas, J.C., *See* Wilson, K.B., 15:36889
Haber, E.A., *See* Kinney, L.F., 15:37059
Habib, P., Solid state mechanics, 15:37162 (R;FR;In French)
Habs, D., *See* Sanders, S.J., 15:37862
Hack, J.E., A kinetic criterion for quasi-brittle fracture, 15:37208 (J;US)
Haddock, R.P., *See* Bosshard, A., 15:37784
Hadjian, A.H., Transactions of the 10th international conference on structural mechanics in reactor technology, 15:36990 (B;US)
Transactions of the 10th international conference on structural mechanics in reactor technology, 15:36991 (B;US)
Transactions on the 10th international conference on structural mechanics in reactor technology, 15:36942 (B;US)
Haendler, B.L., Target materials development, 15:38267 (RA;US)
Haerl, M.H., An economic evaluation of efficiency improvements in residential water heating equipment, 15:37083 (RA;US)
See Brandis, P., 15:37092
See Lerman, D.I., 15:37048
See Peters, J.S., 15:37055
Haga, Tsuneyuki, *See* Yamamoto, Yasushi, 15:38162
Hahm, T.S., *See* Sydora, R.D., 15:38089
Hahn, D., *See* Gilligan, J., 15:38277
Hahn, K., *See* Eylon, S., 15:38297
Hahn, P.A., *See* Radousky, H.B., 15:37275
Hahn, Y., Production of negative hydrogen ions in neutral H+H collisions, 15:37727 (J;US)
Haire, R.G., *See* Chang, C.P., 15:37325
See Stewart, G.R., 15:37223
Hakansson, A., $^{12}C(n,\gamma_0)^{13}C$ cross section in the 8–11 MeV region, 15:37859 (J;US)
Halbach, K., *See* Hopkins, D.B., 15:37483
Halbert, M.L., *See* Morsch, H.P., 15:37877
See Sarantites, D.G., 15:37865
See Wuosmaa, A.H., 15:37864

Halbleib, J.A., *See* Sanford, T.W.L., 15:37445
Halford, V.E., Redesign of the PREPP [Process Experimental Pilot Plant] feed, ash discharge and sludge handling systems, 15:36778 (R;US)
Hall, H.L., *See* Leyba, J.D., 15:37887
Hall, J.H. Jr., *See* Walker, G.A., 15:37593
Hall, N.P., Views and opinions on energy programs and services: Results of focus group interviews with low-income hispanics, blacks, and senior citizens, 15:37108 (RA;US)
Hall, R., Operation of a mobile pilot-scale continuous countercurrent ion exchange system for treatment of low-level radioactive wastewaters, 15:36774 (R;US)
Hall, R.K., *See* Newton, A.A., 15:38157
Haller, M., *See* Comans, R.M.J., 15:37602
Halliday, G., The development of an expert system for heat exchanger selection, 15:37152 (R;GB)
Hallock, G., *See* Booth, W.D., 15:38015
Hallock, G.A., *See* Zielinski, J.J., 15:38081
Halloran, J.W., *See* Ginley, D.S., 15:37261
Haloulakos, V.E., Fusion propulsion systems, 15:38114 (RA;US)
Hamajima, T., *See* Shimada, M., 15:38188
Hamel, W., *See* Jansen, J.F., 15:37373
Hamer, N.D., *See* Alexander, J.B., 15:38343
Hamilton, J.H., *See* Cole, J.D., 15:37518
Hammer, C.F., Confinement physics research facility/ZTH: A progress report, 15:38156 (RA;US)
Hammer, D.A., *See* Adler, L.K., 15:38085
Hammersley, R.J., *See* Carter, J.C. III, 15:36965
See Paik, Chan Y., 15:36968
Hammet, G., *See* Schmidt, G.L., 15:38255
Hammetter, W.F., *See* Samara, G.A., 15:37270
Hammonds, C.J., Thermal and stress analysis of the Faraday shield for the ORNL/TFTR RF antenna, 15:38237 (RA;US)
Hammons, B.E., *See* Vawter, G.A., 15:37418
Hammouda, B., *See* Schupp, G., 15:37336
Han, H., *See* Edwards, B.F., 15:37967
Hancock, C.E., *See* Subbarao, K., 15:37132
Hanold, B., *See* Dennis, B., 15:36861
Hansen, C., *See* Amann, J.F., 15:37773
Hanson, D.A., *See* Fox, J.A., 15:36709
Hanson, P.J., Ontogenetic patterns of CO_2 exchange of Quercus rubra L. leaves during three flushes of shoot growth I. median flush leaves, 15:37656 (J;US)
Ontogenetic patterns of CO_2 exchange of Quercus rubra L. leaves during three flushes of shoot growth II. insertion gradients of leaf photosynthesis, 15:37657 (J;US)
Harber, K.S., Proceedings of the 1989 CESAR/CEA [Center for Engineering Systems Advanced Research/Commissariat a l'Energie Atomique] workshop on autonomous mobile robots (May 30–June 1, 1989), 15:38331 (R;US)
Harbottle, G., *See* Alburger, D.E., 15:37867
Hardaker, J., *See* Kupschus, P., 15:38203
Hariri, H., *See* Carty, R.H., 15:36693
Harjes, H.C., The repetitive high energy pulsed power module, 15:37411 (R;US)
Harkins, D.A., Selected properties of c-perfluorobutane, 15:37286 (R;US)
Harkness, J.B.L., Combined nitrogen oxides/sulfur dioxide control in dry scrubber systems: Volume 2, Evaluation of additives and process modifications: Appendixes, 15:36894 (R;US)
See Livengood, C.D., 15:36707
See Mendelsohn, M.H., 15:36706
Harkreader, S., *See* Lee, A., 15:37113
Harlow, F.H., *See* Besnard, D.C., 15:37739
Harmon, L.H., *See* Schmitt, R.C., 15:36760
See Zelinski, R.W., 15:36808
Harriman, P.N., Parton distributions extracted from data on deep-inelastic lepton scattering, prompt photon production and the Drell-Yan process, 15:37789 (R;GB)
Harris, D.O., *See* Balkey, K.R., 15:36943
Harris, J., *See* Vine, E., 15:37102
Harris, R.A., *See* Padilla, A. Jr., 15:36989
See Silbey, R., 15:37737
Harris, R.M., Recent results on direct photons from CDF [Collider Detector at Fermilab], 15:37760 (R;US)
Harris, T.L., Chlorinated hydrocarbon substitution program, 15:37283 (R;US)
Harrison, F.L., Mercury-binding proteins in the slipper limpet, Crepidula fornicata, exposed to increased soluble mercury, 15:37682 (J;US)
Harrison, R., *See* Amann, J.F., 15:37773
Harrison, W., Impact of accelerated sea level rise on coastal energy facilities, U.S.A., 15:37625 (BA;US)
Harro, E., *See* Fusco, F.A., 15:37303
Hart, A.T., Compendium of MHD-related terminology, 15:37039 (R;US)
Hart, G., *See* Amann, J.F., 15:37773
Hart, G.W., *See* Mischke, R.E., 15:37526
Hart, V., *See* Amann, J.F., 15:37773
Harteneck, B., *See* Levine, J.S., 15:38068
Hartley, D.S. III, Historical validation of an attrition model, 15:37546 (R;US)
Hartung, W., *See* Padamsee, H., 15:37470
Harvey, J.A., [Cooperative research in the area of nuclear physics]: Foreign trip report, May 13–June 12, 1988, 15:37837 (R;US)
Harvey, S.D., *See* Cataldo, D.A., 15:37687
Hasan, M.Z., *See* Kunugi, Tomoaki, 15:38120
See Santarius, J.F., 15:38155
See Wong, C.P.C., 15:38154
Hasegawa, M., *See* Koizumi, K., 15:38178
Hasegawa, Takeo, Analyzing powers of (p vector,2p) reactions at Ep = 3.5 GeV and relativistic effects, 15:37868 (RA;JP;In Japanese)
Haselton, H.H., *See* Becraft, W.R., 15:37432
See Stirling, W.L., 15:38239
See Tsai, C.C., 15:37716
Hashiri, N., *See* Onozuka, M., 15:38200
Hasti, D.E., *See* Mazarakis, M.G., 15:37482
Hastings, J.B., Diffraction broadening and suppression of the inelastic channel in resonant neutron scattering, 15:37312 (J;US)
The use of high-energy synchrotron radiation for x-ray scattering, 15:37510 (R;US)
Hastings, P.S., *See* Kinney, L.F., 15:37059
Hatcher, R.E., PBX-M ohmic heating power supply upgrade, 15:38191 (RA;US)
Hathaway, D., *See* Walthers, C., 15:38135
Hautojaervi, A., *See* Vieno, T., 15:36794
Havlik, S., *See* Dale, M.C., 15:37144
Hawkins, E., *See* Rhodes, B.A., 15:37647
Hawkins, R.J., Stimulated Raman scattering in optical fibers: Polychromatic single-field numerical experiments, 15:37954 (R;US)
Hawthorne, J.E., Scheduling Algorithm for Improving Lift (SAIL): Documentation for initial operating capability, 15:37547 (R;US)
Hay, H.J., The populations of Rydberg states of ions emerging from solid surfaces, 15:37708 (R;AU)
Hay, J.H., *See* Bayes, D.V., 15:38112
Hayano, H., *See* Takeda, S., 15:37449
Haynes, G.R., *See* Leyba, J.D., 15:37887
Haynes, P.S., *See* Smith, R.T.C., 15:38117
Hayward, R.J., COMPASS mechanical design and construction, 15:38115 (RA;US)
Haywood, R., *See* Kim, Kyekyoon, 15:38212
Hazzledine, P.M., Diffusion-accommodated grain boundary sliding in a polycrystal, 15:37179 (R;US)
Head, J.L., *See* Billone, M.C., 15:36997
Heberle, D.P., *See* Tomlinson, J.J., 15:37116
Hedin, E.R., *See* Drake, J.R., 15:38041
Hedley, L., *See* Kupschus, P., 15:38203
Hedrick, D., *See* Phelps, T.J., 15:37626
Heifets, S.A., High repetition rate kickers for linear colliders, 15:37476 (RA;US)
Heiken, G., *See* Goff, S., 15:36863
Heikkinen, D.W., *See* Sale, K.E., 15:37856
Heller, E.J., *See* Ling, Song, 15:37738
Heller, E.K., *See* Tan, Z., 15:37260
Helm, J., *See* Kupschus, P., 15:38203
Helton, J., *See* Montalvo, E., 15:38011

Hembree, D.M., Cold fusion studies: Part 1, Preliminary results from an investigation of the possibility of electrochemically induced fusion of deuterium in palladium and titanium cathodes, 15:38007 (R;US)
Hemon, A., Crystal structure of $Na_3Sr_4Al_5F_{26}$, 15:37174 (J;US)
Crystal structure of $Sr_{10}Al_2F_{25}Cl$, 15:37173 (J;US)
Hemsworth, R.S., *See* Altmann, H., 15:38131
See Massmann, P., *15:38180*
Hender, T.C., *See* Smith, R.T.C., 15:38117
Henderson, D., *See* Sanders, S.J., 15:37862
Henderson, R.A., *See* Leyba, J.D., 15:37887
Henderson, S.D., A search for long-lived low mass states coupling to e^+e^-, 15:37825 (R;US)
Henke, H., Transport and acceleration of low-emittance electron beams, 15:37451 (RA;US)
See Wilson, I., 15:37477
Hennen, L., 'Chernobyl' in the public opinion of the Federal Republic of Germany - risk perception, political attitudes and information, 15:37025 (R;DE;In German)
Hennick, A., *See* Foley, W.J., 15:36979
Henry, C., Econometrics, 15:37010 (R;FR;In French)
Henry, E.A., *See* Becker, J.A., 15:37882
See Stephens, F.S., 15:37883
Henry, R.E., *See* Carter, J.C. III, 15:36965
Hensley, D.C., *See* Morsch, H.P., 15:37877
See Sarantites, D.G., 15:37865
See Wuosmaa, A.H., 15:37864
Henson, T.J., *See* Williams, R.K., 15:37355
Heppenstall, T., *See* Halliday, G., 15:37152
Herman, D.J., *See* Sharifi, M.R., 15:37611
Herman, P., Cost-effectiveness enlightenment: Which is the right test?, 15:37094 (RA;US)
Herman, R.G., *See* Klier, K., 15:37341
Herring, J.S., Parametric design studies of toroidal magnetic energy storage units, 15:38258 (R;US)
See Santarius, J.F., 15:38155
Herrmannesfeldt, W.B., *See* Allen, M.A., 15:37475
Herrmannsfeldt, W.B., *See* Allen, M.A., 15:37501
Hershkowitz, N., *See* Brouchous, D., 15:38087
Hersman, F.W., *See* Kelly, J.J., 15:37857
Hertel, N.E., *See* Miller, G.A., 15:38215
See Palmrose, D.E., 15:38295
Hertzer, D.R., Fire protection review revisit No. 2, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio, 15:36799 (R;US)
Hessing, T.L., Inclusive jet cross section at $\sqrt{s}$ = 1.8 TeV, 15:37757 (R;US)
Hewett, D.W., Numerical investigation of the plasma-grid interaction of the LBL HIF source, 15:37503 (BA;US)
Hewitt, J.D., *See* Hall, R., 15:36774
Hibbs, B.D., *See* Lissaman, P.B.S., 15:36884
Hickok, R.L., *See* Resnick, J., 15:38082
See Schwelberger, J., 15:38073
Hicks, E.G., Third party contracting versus customer programs for commercial/industrial customers, 15:37054 (RA;US)
Hicks, J.B., *See* Smith, R.T.C., 15:38117
Hidaka, Y., *See* Sternlieb, B.J., 15:37268
Hidaka, Yoshiaki, Thermal decomposition of methanol in shock waves, 15:36823 (J;US)
Hidmi, H., *See* Lee, D.H., 15:37728
Hiebert, J.C., *See* Glass, G., 15:37786
Higashihara, Tetsuo, *See* Hidaka, Yoshiaki, 15:36823
Higo, T., *See* Allen, M.A., 15:37475, 15:37501
Hildenbrand, D.L., *See* Lau, K.H., 15:37353
Hill, D.J., An overview of the EBR-II PRA [Probabilistic Risk Assessment], 15:36956 (R;US)
Hill, J.C., *See* Winger, J.A., 15:37861
Hill, K.W., *See* Stratton, B.C., 15:38036
Hilliard, J., *See* Frye, G.G., 15:37238
Himes, R.M., *See* Muzio, L.J., 15:36897
Himes, V.L., *See* Carr, M.J., 15:38347
Hinks, D.G., *See* Kwok, W.K., 15:37986
Hiratsuka, H., *See* Onozuka, M., 15:38200
Hirst, E., Evaluating energy-efficiency programs: A personal view of progress and potential, 15:37115 (RA;US)
Integrated resource planning for electric and gas utilities, 15:37033 (R;US)
The federal government should do more to improve US energy efficiency, 15:37030 (R;US)
See Schweitzer, M., 15:37038
Hiruta, K., *See* Kuriyama, M., 15:38144
Hiskes, J.R., Recombination and dissociation of H_2^+ and H_3^+ ions on surfaces to form $H_2(v'')$: Negative-ion formation on low-work-function surfaces, 15:37736 (J;US)
Hively, L., *See* Montalvo, E., 15:38011
Hiyama, T., *See* Okuno, K., 15:38104
Ho, C.M., Laser spark ignition of laminar CH_4/air mixtures, 15:36753 (BA;US)
Ho, L., *See* Chen, S.L., 15:36708
Ho, P., Laser techniques for studying chemical vapor deposition, 15:37239 (R;US)
Ho, S.K., An estimation of radiological hazards of current tokamak reactor concepts, 15:38170 (RA;US)
Hoag, H.A., *See* Allen, M.A., 15:37475, 15:37501
Hoag, J.E., *See* Brooks, E.D. III, 15:38339
See Brooks, E.D. III., 15:38337
Hoek, M., McSUB, a Monte Carlo Library for neutron transport in two different media for the neutron energy range 0.1-20 MeV, 15:37923 (R;SE)
Method of energy calibration of the TANSY neutron detectors, 15:37516 (R;SE)
Hoeksema, R.J., Cokriging model for estimation of water table elevation, 15:37627 (J;US)
Hoener, C.F., Production and depletion of long-lived charged non-bond-alternating defects in polyacetylene with mid-band-gap photolysis, 15:37323 (J;US)
Hoenig, C., Densification studies of refractory materials using Hot Isostatic Pressing (HIP) and tantalum containment, 15:37243 (R;US)
Hoffer, J.K., The effects of exchange gas temperature and pressure on the beta-layering process in solid deuterium-tritium fusion fuel, 15:38260 (R;US)
Hoffman, D.J., *See* Caughman, J.B.O. II, 15:38129
See Hammonds, C.J., 15:38237
Hoffman, G.L., *See* Batte, G.L., 15:36946
Hofman, G.L., *See* Pahl, R.G., 15:36924
Hofmann, G., MAB-project 6 'Research for the ecological system Berchtesgaden': Climatological measurements at the Alpine National Park, wind systems and inversions. Disciplinary report FB 07 climatology, 15:37585 (R;DE;In German)
Hogan, B., *See* Calame, J., 15:38069
See Lawson, W., 15:37481
Hogan, G.E., *See* Mischke, R.E., 15:37526
Hogan, J.T., *See* Bartlit, J.R., 15:38151
See Peng, Y.K.M., 15:38014
Holian, B.L., Time-reversible equilibrium and nonequilibrium isothermal-isobaric simulations with centered-difference Stoermer algorithms, 15:37396 (J;US)
Holinde, K., *See* Gross, F., 15:37910
Holland, D.F., *See* Lyon, R.E., 15:38247
Holland, J.W., *See* Liu, Y.Y., 15:36961
See Morman, J.A., 15:36916
Holland, O.W., *See* Singh, R.K., 15:37251
Holmes, J.A., *See* Carreras, B.A., 15:38016
Holmes, J.P., A performance evaluation of biometric identification devices, 15:38346 (R;US)
Holmes, S., *See* Chong, S.L., 15:36756
Holst, B., The HNEI/Kahua wind energy storage test facility, 15:36883 (BA;US)
Holt, J.K., *See* Rasnake, D.G., 15:37041
Holt, R.J., Exclusive photonuclear reactions and asymptotic scaling, 15:37916 (J;US)
Holton, J.K., *See* Gordon, H.T., 15:36855
Homan, F.J., [Liquid metal reactor/fast breeder reactor research and development]: Foreign trip report, June 4, 1990–June 9, 1990, 15:36927 (R;US)
Homicz, G.F., VAWT stochastic loads using a 3-D turbulence simulation, 15:36882 (BA;US)
Hommert, P.J., *See* Thorne, B.J., 15:37399

Hong, D.K., Towards a bosonization of quantum electrodynamics, 15:37815 (J;US)
Hong, J.M., *See* Shi, D., 15:37250
Hong, R., Beam current regulation of DIII-D neutral beam long pulse ion sources, 15:38142 (RA;US)
Honkanen, K., *See* Nicolis, N.G., 15:37871
Hooper, E., *See* Casper, T., 15:38276
Hooper, E.B., Physics study of the application of an IFEL [Induction Free-Electron Laser] to CIT [Compact Ignition Tokamak]: Interim report, 15:38275 (R;US)
See Mizuno, K., 15:38079
Hoover, C.G., *See* Holian, B.L., 15:37396
Hoover, W.G., *See* Holian, B.L., 15:37396
Hopkins, D.B., An FEL power source for a TeV linear collider, 15:37483 (RA;US)
Hopkins, M.E., *See* Hirst, E., 15:37033
Hopper, R.J., Integration of the natural gas markets in Western Europe, 15:36745 (BA;US)
Hoppler, D.E., Department of Energy Strategic Defense Initiative programs: Potential programmatic and facility impacts due to a prospective defense and space treaty, 15:37554 (R;US)
Horen, D.J., *See* Auble, R.L., 15:37889
Horie, T., Stress analysis of JT-60U tokamak, 15:38228 (RA;US)
See Horiike, H., 15:38164
Horiike, H., Present status of JT-60 upgrade, 15:38164 (RA;US)
Horikoshi, G., KEK plans for a linear collider R & D, 15:37437 (RA;US)
Horiike, H., *See* Horie, T., 15:38228
Hornbostel, M., *See* Vassiliou, J.K., 15:37166
Horowitz, M.J., *See* Cody, B., 15:37112
Horwedel, J.E., Automated sensitivity analysis with the Gradient Enhanced Software System (GRESS), 15:38329 (R;US)
Horwitz, N., *See* Bortoletto, D., 15:37781
Hoshizaki, Norio, Phase shift analysis of nucleon-nucleon scattering, 15:37897 (RA;JP)
Hosono, Kazuhiko, *See* Katayama, Ichiro, 15:37509
Hosoyama, Kenji, Large-load cryostat for UTS, 15:37376 (RA;JP;In Japanese)
Hotta, Akio, Measurements of magnetic form factor of nucleon and few nucleon system, 15:37827 (RA;JP;In Japanese)
Houee-Levin, C., Search for Urbach tails in the optical absorption spectra of solvated electrons in alcohols and water, 15:37358 (J;US)
Houlberg, L.M., Environmental regulatory update table, March 1990, 15:37013 (R;US)
Environmental regulatory update table, April 1990, 15:37014 (R;US)
Environmental regulatory update table, May 1990, 15:37015 (R;US)
Houpis, J.L.J., *See* Kercher, J.R., 15:37586
House, L., *See* Duchane, D.V., 15:36870
Houssenbay, S., Nature of the different nickel species in sulfided bulk and alumina-supported NiMo hydrotreating catalysts, 15:37215 (J;US)
Houston, P.L., *See* Misaizu, F., 15:37357
Howard, B.D., Thermal energy storage in building interiors, 15:36852 (BA;US)
Howard, W.M., A site for the astrophysical gamma-ray process, 15:37696 (R;US)
Howe, H., *See* Montalvo, E., 15:38011
Howe, H.C., *See* Ordonez, C.A., 15:38130
Howe, T.L., *See* Weakley, S.A., 15:37127
Howell, C.R., *See* Pedroni, R.S., 15:37872
Howell, J., *See* Ordonez, C.A., 15:38130
Hoyer, E.H., *See* Hopkins, D.B., 15:37483
Hsiao, M.C., *See* Sinha, A., 15:37354
Hsieh, K., *See* Montalvo, E., 15:38116
Hsieh, K.T., Electromechanical analysis of a prototype 20 TESLA, single turn toroidal field coil for IGNITEX, 15:38173 (RA;US)
See Werst, M.D., 15:38293
Hsing, W.W., Holographic interferometry of gas-puff Z-pinches, 15:38075 (BA;US)
Hsueh, C.M., *See* Schupp, G., 15:37336
Hu Jingxin, *See* Zhou Zhihong, 15:37368
Hu, B., *See* Kim, S., 15:38004
Hu, P.S., *See* Williams, L.S., 15:37139
Hu, S., Ash and burn control in ITER-type tokamak, 15:38291 (BA;US)
Huang, B.Y., *See* Oliver, B.F., 15:37193
Huang, G.L., *See* Huang, Z.Q., 15:37541
Huang, H., Spray-dryer flue-gas-cleaning systems handbook, 15:36892 (R;US)
See Holst, B., 15:36883
Huang, H.S., *See* Harkness, J.B.L., 15:36894
Huang, W., *See* Das, A., 15:38000
Huang, Z.Q., Observation of molecular vibrations in the time domain with incoherent laser pulses, 15:37541 (J;US)
Huber, J.G., Superconductivity under high pressure of $YBa_2(Cu_{1-xMx})_3O_{7-\delta}$ (M=Fe, Co, Al, Cr, Ni, and Zn), 15:37264 (J;US)
Huckfeldt, C.R., *See* Schmidt, J.W., 15:37624
Huels, M.A., Charge transfer and electron detachment for collisions of H^- and D^- with H, 15:37731 (J;US)
Huenneke, L.F., Substrate heterogeneity and regeneration of a swamp tree, Nyssa aquatica, 15:37608 (J;US)
Huggins, R.A., *See* Crouch-Baker, S., 15:37003
Hughes, R.C., Microsensor research, 15:37409 (R;US)
Hugo, T., *See* Takeda, S., 15:37449
Hulbert, S.L., *See* Ade, H., 15:37543
Hull, D., *See* Kempton, W., 15:37070
Hull, J.R., *See* Moon, F.C., 15:37227
Hulse, R., *See* Schmidt, G.L., 15:38255
Hulse, R.A., *See* Stratton, B.C., 15:38036
See Synakowski, E.J., 15:38034
Hulstrom, R., *See* Riordan, C., 15:36827
Hulstrom, R.L., *See* Riordan, C.J., 15:36829
Hummel, K.E., Integrating expert systems with solid modeling through interprocess communications and the applications interface specification, 15:38319 (R;US)
Humphrey, S.R., *See* Simons, R.W., 15:37594
Humphries, S., *See* Hewett, D.W., 15:37503
Humphries, S. Jr., *See* Wilson, J.M., 15:37446
Hunley, A.E., *See* Hoeksema, R.J., 15:37627
Hunsaker, C.T., *See* Hunsaker, D.B. Jr., 15:36901
Hunsaker, D.B. Jr., Assessing the potential environmental impacts of proposed rules affecting future electric power generation in the United States, 15:36901 (R;US)
Huomo, H., *See* Henderson, S.D., 15:37825
Hurley, K., *See* Boer, M., 15:37692
Huttar, D., *See* Neumeyer, C., 15:38189
Hutton, A., Sizing the vacuum chambers conservatively, 15:37484 (R;US)
See Donald, M., 15:37454
Hwang, I., *See* Ballinger, R., 15:38219
Hybertsen, M.S., Renormalization from density-functional theory to strong-coupling models for electronic states in Cu-O materials, 15:37985 (J;US)
Hyde-Wright, C., *See* Kelly, J.J., 15:37857
Hynes, M.V., *See* Kelly, J.J., 15:37857

I

Iacono, M.J., *See* Gutowski, W.J., 15:37565
Ichimura, M., *See* Brouchous, D., 15:38087
Ide, T., *See* Bartlit, J.R., 15:38102
See Walthers, C., 15:38135
Idelon, C., *See* Pain, M., 15:38167
Iiyoshi, Atsuo, Present status of the Large Helical Device project, 15:38150 (RA;US)
Ikeda, S., *See* Watanabe, N., 15:37945
Ikegami, H., *See* Yosoi, M., 15:37532
Imazu, A., *See* Livolant, M., 15:36996
Imre, D.G., *See* Ling, Song, 15:37738
Ingemarsson, I., A protocol to set up shared secret schemes without the assistance of a mutually trusted party, 15:38345 (R;US)
Ingraham, J.C., *See* Weber, P.G., 15:38063
Ingram, B.S., *See* Hayward, R.J., 15:38115
Inokuti, M., Alternative forms of the Spencer-Fano equation, 15:37934 (J;US)
Intrator, T., *See* Brouchous, D., 15:38087
Inui, Y., *See* Yoshikawa, K., 15:38224

Iris, P., Heat pump and heliogeothermal space heating Aulnay-sous-Bois. The 1985 season, 15:36872 (R;FR;In French)
Ironside, K.S., *See* Tyndall, R.L., 15:37655
Irvine, T.F. Jr., *See* Greene, G.A., 15:37392
Isebrands, J.G., *See* Hanson, P.J., 15:37656, 15:37657
Ishihara, N., *See* Takeda, S., 15:37449
Ishihara, O., *See* Xia, H., 15:38058
Ishikawa, M., *See* Yoshikawa, K., 15:38224
Ishimoto, Shigeru, *See* Adachi, Toshikazu, 15:37898
Islam, M.S., *See* Sale, K.E., 15:37856
Isono, T., *See* Nishi, M.F., 15:38098
See Okuno, K., 15:38104
Itahashi, T., *See* Tanaka, M., 15:37498
Iundt, F., *See* Sabroux, J.C., 15:36865
Iversen, S., *See* Seth, K.K., 15:37860
Iwamoto, S., *See* Onozuka, M., 15:38200
Izabel, C., *See* Escalier des Orres, P. Devillers, 15:36770
See Lewi, J., 15:36767

J

Jaanimagi, P.A., *See* Delettrez, J., 15:38306
Jaccard, D., *See* Amato, A., 15:37288, 15:37979
Jackson, M.C., Microwave Tokamak Experiment (MTX) first year of operation and future plans, 15:38166 (RA;US)
Microwave Tokamak Experiment (MTX) ohmic heating system, 15:38220 (RA;US)
Jackson, R.H., *See* Bluen, H., 15:38282
Jacobsen, R., The silicon strip detector at the Mark 2, 15:37534 (R;US)
Jacobson, R., *See* Golf, F., 15:36864
Jacquinot, J., *See* Pain, M., 15:38167
Jadach, S., The renormalization group improved YFS [Yennie-Frautschi-Suura] method in QED, 15:37795 (J;US)
Jaeger, D.L., *See* Vigil, A.S., 15:37550
Jaeger, E.F., *See* Eways, S.E., 15:38009
Jagger, J.W., *See* Pavlovsky, D.A., 15:38235
See Terry, D.R., 15:38242
Jahan, M.S., *See* Cooke, D.W., 15:37259
Jain, P., Relativistic energy-momentum relationship for a soliton, 15:37823 (J;US)
Jain, V., *See* Bortoletto, D., 15:37781
See Burton, J.W., 15:37999
Jalbert, R.A., *See* Bartlit, J.R., 15:38102
James, R.B., *See* Bao, X.J., 15:37248
Jancaitis, K.S., *See* Campbell, J.H., 15:37413
Jansen, J.F., Stiffness control of teleoperators with redundant, dissimilar kinematics, 15:37373 (R;US)
Janson, B.N., Feasibility of exclusive facilities for cars and trucks: Final report, 15:37140 (R;US)
Janssens, R.V.F., *See* Kaczarowski, R., 15:37878
See Sanders, S.J., 15:37862
Jardin, S.C., Physics overview of CIT, 15:38201 (RA;US)
See Bathke, C.G., 15:38145
See Kessel, C.E., 15:38146
See Peng, Y.K.M., 15:38014
See Strickler, D.J., 15:38123
Jarrell, W.M., *See* Sharifi, M.R., 15:37611
Jastrzembski, E., *See* Ohl, K.E., 15:37785
Jaszczak, R.J., SPECT [single photon emission computed tomography] assay of radiolabeled monoclonal antibodies: Progress report, September 1989–April 1990, 15:37645 (R;US)
Jay-Gerin, J.P., *See* Houee-Levin, C., 15:37358
Jean-Marie, B., *See* Augustin, J.E., 15:37764, 15:37765
Jenkins, M.G., Determination of the stress distributions in a ceramic: Tensile specimen using numerical techniques, 15:37229 (R;US)
Jennings, J., *See* Cody, B., 15:37112
Jennings, S.D., KWOC [Key-Word-Out-of-Context] Index of US Nuclear Regulatory Commission Regulatory Guide Series, 15:37031 (R;US)
Jennison, D.R., *See* Hybertsen, M.S., 15:37985
Jensen, S.M., Postirradiation examination results from the LP-FP-2 center fuel module, 15:36970 (R;US)
Jeppson, D.W., Behavior of radioactive species during water injection into alloy breeder material, 15:38173 (RA;US)
Jernigan, J.G., *See* Shapiro, S.L., 15:37533
Jernigan, T.C., *See* Baylor, L.R., 15:38245
See Combs, S.K., 15:38225
Jesson, D.E., *See* Pennycook, S.J., 15:37281, 15:37941
Jessop, E.S., *See* Campbell, J.H., 15:37413
Jiang, L., Real plasma effects of microwave radiation propagating perpendicular to a magnetized plasma, 15:38077 (BA;US)
Jiang, M.F., Uncertainties in the two-nucleon potential and nuclear matter predictions, 15:37913 (J;US)
Jiang, Xingjian, *See* Schlesinger, M.E., 15:37566
Jiao Rongzhou, *See* Zheng Hualing, 15:37367
Jin LI, *See* Brunsell, P., 15:38045
See Drake, J.R., 15:38041
Jody, B.J., Recycling of plastics in automobile shredder residue, 15:37142 (R;US)
Utilization of off-peak electric power to improve cycle efficiency during peak demand periods, 15:36887 (R;US)
Johnson, A.R., *See* Schmidt, J.W., 15:37624
Johnson, D.J., *See* Woodworth, J.R., 15:38283
Johnson, D.L., *See* Prestwich, K.R., 15:38262
See Sanford, T.W.L., 15:37445
Johnson, D.W., Acidic deposition on Walker Branch Watershed: Volume 1. Gas studies, 15:37606 (BA;US)
See Stratton, B.C., 15:38036
See Synakowski, E.J., 15:38034
Johnson, E.D., *See* Ade, H., 15:37543
Johnson, K.F., *See* Glass, G., 15:37786
Johnson, L.R., *See* Larsen, R.P., 15:37156
Johnson, M., Spin-polarized scanning tunneling microscope: Concept, design, and preliminary results from a prototype operated in air, 15:37423 (J;US)
Johnson, M.F., *See* Tanga, A., 15:38012
Johnson, N.R., *See* Sarantites, D.G., 15:37865
Johnson, P.A., Nonlinear elastic wave interactions in rock, 15:37287 (R;US)
Johnson, R., *See* Eylon, S., 15:38297
Johnson, S.G., Spectral hole burning and flourescence studies of a synthetic chlorophyll dimer, a bacterial antenna system and a bacterial reaction center, 15:36832 (R;US)
Jones, D.T.L., A national photon dosimetry intercomparison, 15:37529 (R;ZA)
Jones, D.W., Forces shaping the energy required to support western hemisphere development, 15:37027 (R;US)
Jones, E.C., *See* Norton, D.P., 15:37249
Jones, J.P., [Computer vision and robotics]: Foreign trip report, January 22, 1989–January 28, 1989, 15:38328 (R;US)
Jones, M.E., *See* Ziemniak, S.E., 15:37236
Jones, N.S., *See* Gordon, H.T., 15:36855
Jones, P., *See* Walker, G.A., 15:37593
Jones, T.L., *See* Fayer, M.J., 15:36784
Jones, T.T.C., *See* Bickley, A.J., 15:38253
Jong, R.A., *See* Hopkins, D.B., 15:37483
Joshi, C., *See* Williams, R., 15:38056
Jousset, J., *See* Augustin, J.E., 15:37765
Joynt, R., *See* Kwok, W.K., 15:37986
Ju, C.P., *See* Chen, C.H., 15:37200
Julien, D.S., *See* Norton, D.P., 15:37249
Julien, J.T., Leak rate test of containment personnel lock, 15:36978 (RA;US)
Junck, K.L., Emission spectroscopy of ECRH non-axisymmetric helium mirror plasmas, 15:38080 (BA;US)
Jung-Choon Im, C., Noodles and stars allow a precise and efficient calculation of the Z-line shape and the polarization asymmetry, 15:37796 (J;US)
Juul Rasmussen, J., *See* Als-Nielsen, J., 15:37952

K

Kaczarowski, R., Lifetimes of high spin states in ^{181}Ir and ^{180}Os, 15:37878 (J;US)

Kadish, A., A theory of weak transient electrical discharges on dielectric surfaces, 15:38094 (J;US)
Charge transport dynamics in surface flashover arcs, 15:38086 (BA;US)
Kadkhodayan, B.A., *See* Leyba, J.D., 15:37887
Kaegler, S.H., Analytical methods for metals in petroleum and related products, 15:36737 (R;DE;In German)
Kai, T., *See* Kaneko, O., 15:38240
Kaletka, M., *See* Seth, K.K., 15:37860
Kalia, R.K., *See* Vashishta, P., 15:37300
Kalimullah, *See* Tentner, A.M., 15:36918
Kalina, J., *See* Crandall, R.S., 15:36839
Kaluzny, Y., *See* Lewi, J., 15:36767
Kam, F.B.K., *See* Stallmann, F.W., 15:36907
Kaminsky, E., *See* McDade, J., 15:38241
Kampwirth, R.T., *See* Kim, D.H., 15:37279
Kanada, H., A phase shift analysis of proton-proton scattering in P_L = 1.0 - 2.2 GeV/c region and diproton resonances, 15:37896 (RA;JP)
Kanakidou, M., Contribution on the study of light non methane hydrocarbons sources in the atmosphere, 15:37569 (R;FR;In French)
Kanciruk, P., *See* Farrell, M.P., 15:37563
Kaneko, O., Design and construction of the neutral beam injector for compact helical system (CHS), 15:38240 (RA;US)
Kang, J., *See* Allen, J.W., 15:37271
Kang, Sang-Wook, Species-diffusion phenomena in glass: A one-dimensional, transient model, 15:37297 (R;US)
Kania, D.R., Absolute x-ray power measurements with subnanosecond time resolution using type IIa diamond photoconductors, 15:37308 (J;US)
Kapteyn, H.C., *See* Murnane, M.M., 15:37544
Karditsas, P.J., The electron energy distribution function of noble gases with flow, 15:38061 (BA;US)
See Talaat, M.E., 15:38289
Kare, J.T., 1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion: Proceedings, 15:37138 (R;US)
Karita, A., *See* Kaneko, O., 15:38240
Karlsson, P., Thomson scattering measurements on the high beta pinch Extrap-T1, 15:38046 (R;SE)
See Drake, J.R., 15:38041
Karnitz, M.A., *See* McLain, H.A., 15:37135
Karo, A.M., *See* Hiskes, J.R., 15:37736
Karr, T., Perturbation growth by thermal blooming in turbulence, 15:37742 (J;US)
Karydas, D., *See* Balkey, K.R., 15:36943
Kasha, H., *See* Ohl, K.E., 15:37785
Kassner, T.F., Environmentally assisted cracking in light water reactors: Semiannual report, October 1988–March 1989: Volume 8, 15:36906 (R;US)
Kasztelan, S., *See* Houssenbay, S., 15:37215
Katayama, Ichiro, The physics of Beam Circulation Rings and their future aspects, 15:37509 (RA;JP;In Japanese)
Kato, Syohei, The importance of gamma-ray measurement in nuclear reaction research, 15:37839 (RA;JP;In Japanese)
Kato, T., *See* Okuno, K., 15:38104
Katori, K., *See* Tanaka, M., 15:37498
Katsouleas, T., *See* Williams, R., 15:38056
Kawabata, Yuji, Neutron reflectometer, 15:37522 (RA;JP;In Japanese)
Kawai, Hideyuki, Experiment of measuring neutron life, 15:37926 (RA;JP;In Japanese)
Kawai, M., *See* Kuriyama, M., 15:38144
Kawai, Takeshi, Superfluidity helium type UCN converters, 15:37928 (RA;JP;In Japanese)
See Utsuro, Masahiko, 15:36948
Kawamata, Youichi, Test on fast data transfer between a VME-bus system and a CAMAC system, 15:38030 (R;JP;In Japanese)
Kawamoto, E.H., *See* Schwartz, D.K., 15:37748
Kawamoto, T., *See* Takeda, S., 15:37449
Kawano, Hiroyuki, *See* Hidaka, Yoshiaki, 15:36823
Kawasaki, K., *See* Mizuno, K., 15:38079
See Onozuka, M., 15:38200
Kawata, S., *See* Mizuno, K., 15:38057
Kazakov, V.A., *See* Ambjoern, J., 15:37809
Kedl, R.J., Conventional wallboard with latent heat storage for passive solar applications, 15:37117 (R;US)
Keeney-Walker, J., *See* Naus, D.J., 15:36995
Kegel, J., *See* Laitner, S., 15:37103
Kelbaugh, D., *See* Prowler, D., 15:36851
Keller, J.O., Pulse combustion: The quantification of characteristic times, 15:37397 (J;US)
Keller, J.W., *See* Alexander, J.B., 15:38343
Kellman, D., *See* Hong, R., 15:38142
Kellogg, G.J., *See* Schwartz, D.K., 15:37748
Kellogg, M., *See* Scott, M., 15:36710
Kellogg, M.A., *See* Klan, M.S., 15:37126
Kelly, C.A., *See* Cook, R.B., 15:37613
Kelly, J.G., *See* McCrory, F.M., 15:36949
Kelly, J.J., Effective interactions and nuclear structure using 180 MeV protons. I. $^{16}O(p,p')$, 15:37857 (J;US)
Kelly, W.H., *See* Stephens, F.S., 15:37883
Kelzenberg, J.C., Fundamental studies of supported ruthenium catalysts: Model reaction studies and NMR [nuclear magnetic resonance] of adsorbed molecules, 15:36699 (R;US)
Kemper, K.W., *See* Trcka, D.E., 15:37853
Kempton, W., Residential direct load control: Comfort effects and predictors of load savings, 15:37070 (RA;US)
Kenefick, R.A., *See* Glass, G., 15:37786
Kerby, J.S., *See* Markely, F.W., 15:37405
Kercher, J.R., Conceptualization of TREE: A model of the effects of acid precipitation and air pollutants on the growth of trees: Progress report, 15:37586 (R;US)
Kerchner, H.R., *See* Christen, D.K., 15:37228
See Thompson, J.R., 15:37976
Kern, D., *See* Ade, H., 15:37543
Kessel, C.E., Plasma vertical stability and feedback control for CIT, 15:38146 (RA;US)
Kessler, S.F., *See* Padilla, A. Jr., 15:36928
Keszler, D.A., *See* Smith, R.W., 15:37175
Ketcham, T.D., *See* Norton, D.P., 15:37249
Ketterson, J.B., *See* Moreau, A., 15:37207
Kewish, R.W. Jr., Quality assurance and quality control for the confinement physics research facility (CPRF) and ZTH experiment, 15:38110 (RA;US)
Key, J.L., *See* Mansfield, M.A., 15:37672
Keyes, T., *See* Madan, B., 15:37364
Kharzeev, D.Eh., Neutral strange particle production in antiproton-nucleus annihilation at low energies, 15:37895 (R;SU)
Khater, H.Y., Dose rate calculations for a light ion beam fusion Laboratory Microfusion Facility, 15:38233 (RA;US)
See Emmert, G.A., 15:38163
Khoo, T., *See* Sanders, S.J., 15:37862
Khoo, T.L., *See* Kaczarowski, R., 15:37878
Kibedi, T., *See* Dracoulis, G.D., 15:37873, 15:37875
See Fabricius, B., 15:37874
Kieffer, J., *See* Syed, R., 15:37301
Kiefner, J.F., A modified criterion for evaluating the remaining strength of corroded pipe: Final report, 15:36749 (R;US)
Kielczewska, D., Interpretation of the kinematical properties of SN 1987A neutrino data by an admixture of $\nu_\mu,\nu_{\bar{\mu}}$ and $\nu_\tau,\nu_{\bar{\tau}}$, 15:37701 (J;US)
Kikuchi, K., *See* Kuriyama, M., 15:38144
Kikuta, S., *See* Ando, M., 15:37944
Kim, C., *See* Cammarata, R.C., 15:37205
Kim, D., Magnesium atoms in an intense nonresonant laser field, 15:37732 (J;US)
See Saeed, M., 15:37417
Kim, D.H., Lorentz-force independence of resistance tails in magnetic fields near T_c for the low-temperature superconductor granular NbN: A Josephson-junction model, 15:37279 (J;US)
Kim, H.J., Advanced study in solid transport: Rheological behavior of dense suspension: Sixth quarterly report, January 1, 1990–March 31, 1990, 15:36711 (R;US)
Multinucleon transfer reactions for the $^{50}Ti+^{93}Nb$ system at sub- and near-barrier energies, 15:37869 (R;US)
Kim, I.C., *See* Thovert, J.F., 15:37968
Kim, J., *See* Hong, R., 15:38142
Kim, J.S., *See* Stewart, G.R., 15:37223

Kim, Jinchoon, Radiation shielding analysis for DIII-D, 15:38118 (RA;US)
See Bhadra, D.K., 15:38010
Kim, Kyekyoon, Results from recent hydrogen pellet acceleration studies with a 2-m railgun, 15:38212 (RA;US)
Kim, S., Scaling pattern of period doubling in four dimensions, 15:38004 (J;US)
Kim, S.S., *See* Ryskamp, J.M., 15:36950
Kim, Y., *See* Lee, P.C.Y., 15:37970
Kimura, H., *See* Moriyama, S., 15:38236
Kimura, T., *See* Arakawa, K., 15:38158
Kimura, Toyoaki, *See* Kawamata, Youichi, 15:38030
Kimura, W.D., *See* Tidwell, S.C., 15:37419
Kimura, Y., *See* Horikoshi, G., 15:37437
See Takeda, S., 15:37449
Kincaid, J.M., Theoretical studies of multicomponent mixtures: Phase equilibrium and transport: Progress report, September 1, 1988–May 15, 1990, 15:37282 (R;US)
King, A.W., A plan for intermodel comparison of atmospheric CO_2 projections with uncertainty analysis, 15:37571 (R;US)
King, M., *See* Jacobsen, R., 15:37534
King, R.W., Real-time LMR control parameter generation using advanced adaptive synthesis, 15:36917 (R;US)
King, T., *See* Kim, Kyekyoon, 15:38212
Kingston, J.J., *See* Wellstood, F.C., 15:37420
Kinney, L.F., Short-term energy evaluation program (STEEP) of the Illinois Weatherization program, 15:37059 (RA;US)
Kinoshita, M., *See* Misaizu, F., 15:37357
Kintz, G., *See* Esterowitz, L., 15:37425
Kirchgessner, J., *See* Padamsee, H., 15:37470
Kirkpatrick, D.A., *See* Gold, S.H., 15:38279
Kirsch, L.E., Research in elementary particle physics: Technical progress report, June 1, 1989–May 31, 1990, 15:37753 (R;US)
Kirz, J., *See* Ade, H., 15:37543
Kitamura, S., *See* Kuriyama, M., 15:38144
Kitsopoulos, T., *See* Robie, D.C., 15:37363
Kiyanagi, Yoshiaki, Generation of spallation neutrons, 15:37929 (RA;JP;In Japanese)
Klabunde, C.E., *See* Christen, D.K., 15:37228
Klan, M.S., Multicomponent case weights for the 1985 resample of the 1983 Pacific Northwest residential energy survey, 15:37126 (R;US)
Klasky, M., *See* Peng, Y.K.M., 15:38014
Klein, A., *See* Alde, D.M., 15:37782
Klems, J.H., U-values, solar heat gain and thermal performance: Recent studies using the MoWITT, 15:37134 (BA;US)
Klier, K., Mechanisms and controlling characteristics of the catalytic oxidation of methane: Final technical report, June 15, 1986–June 14, 1990, 15:37341 (R;US)
Klimas, P.C., The Sandia/DOE/USDA 34-meter-diameter vertical axis wind turbine test bed, 15:36880 (BA;US)
Kline, S., *See* Carty, R.H., 15:36693
Klingner, P.L., *See* Wilkins, R.W., 15:38244
Kloet, W.M., Parity-violating asymmetry in $\vec{p}\ p$ scattering at medium energies, 15:37911 (J;US)
Knauer, J., *See* Moreno, J.C., 15:37414
Kneringer, G., *See* Staffler, R., 15:38134
Knight, P.A., *See* Kinney, L.F., 15:37059
Knutson, B.J., *See* Padilla, A. Jr., 15:36989
Kny, E., *See* Staffler, R., 15:38134
Kobayashi, H., *See* Takeda, S., 15:37449
Kobayashi, K., *See* Kobayashi, Y., 15:37778, 15:37828
Kobayashi, Makoto, Proceedings of the workshop 'topology, field theory and superstrings', 15:37806 (R;JP)
Kobayashi, N., *See* Moriyama, S., 15:38236
Kobayashi, Y., Analyzing power measurements in pp elastic scattering with an internal target, 15:37828 (RA;JP)
PP scattering with an internal target, 15:37778 (RA;JP)
Koch, J.H., *See* Naus, H.W.L., 15:37919
Kocher, D.C., Classification and disposal of radioactive wastes: History and legal and regulatory requirements, 15:36773 (R;US)
Koehne, R., Research and development program on solar thermal use in the high temperature range, 15:36845 (R;DE;In German)
Koenig, J.F., *See* Lahm, C.E., 15:36919
Koestler, C., Microstructure of melt spun Nd-Fe-Co-B magnets, 15:37209 (J;US)
Kogan, V.G., Forces upon vortices in anisotropic superconductors, 15:37982 (J;US)
Kohler, D.A., *See* Filbert, P.C., 15:38076
Kohmoto, T., *See* Kaneko, O., 15:38240
Koizumi, K., Design study of the FER (fusion experimental reactor) superconducting magnet system, 15:38178 (RA;US)
See Horiike, H., 15:38164
See Nishi, M.F., 15:38098
Kolar, O.C., Forecast of criticality experiments needed to support US DOE contractor operations, 1987–1992, 15:36800 (R;US)
Kolb, E.W., *See* Frieman, J.A., 15:37703
Kolodner, P., *See* Fineberg, J., 15:37391
Kolonko, J., *See* Barletta, W.A., 15:37447
Koltun, D.S., Theory of the isotensor term in the pion-nucleus optical potential, 15:37912 (J;US)
Komata, M., *See* Kuriyama, M., 15:38144
Kometani, H., *See* Yoshikawa, K., 15:38224
Kondo, M., *See* Tanaka, M., 15:37498
Kondow, T., *See* Misaizu, F., 15:37357
Kong, M.K., *See* Campbell, J.H., 15:37413
Konishi, Satoshi, *See* Naruse, Yuji, 15:38106
Konno, M., *See* Koizumi, K., 15:38178
See Nishi, M.F., 15:38098
Konter, J.A., *See* Bosshard, A., 15:37784
Koo, Y.M., *See* Dale, M.C., 15:37144
Kook, H., Diffusion in symplectic maps, 15:38001 (J;US)
Koontz, R.F., *See* Allen, M.A., 15:37475, 15:37501
Korellis, J.S., Compendium of material test results on HY-130 and Ti-3Al-2V metals in support of United States Navy programs: Interim report, 15:37197 (R;US)
Korhonen, R., *See* Vieno, T., 15:36794
Kornblum, H., *See* Kania, D.R., 15:37308
Korner, H., *See* Sanders, S.J., 15:37862
Koros, W.J., *See* Baker, R.W., 15:37147, 15:37148
Kortbawn, D., *See* Lovell, T.W., 15:38284
Korten, W., *See* Becker, J.A., 15:37882
See Stephens, F.S., 15:37883
Kovar, D.G., *See* Sanders, S.J., 15:37862
Kovash, M.A., *See* Kelly, J.J., 15:37857
Kowari, K., *See* Inokuti, M., 15:37934
Koyama, Atsushi, *See* Nomura, Masaharu, 15:37488
Kozlowski, M.R., Large area laser conditioning of dielectric thin film mirrors, 15:38273 (R;US)
See Wolfe, C.R., 15:37244, 15:38272
Kozub, T.A., Initial performance and characteristics of the PBX-M pellet injector, 15:38209 (RA;US)
Kraitchman, M., *See* Ceder, G., 15:37263
Krakowski, R.A., *See* Bartlit, J.R., 15:38151
Kramer, J.M., Fuel damage during off-normal transients in metal-fueled fast reactors, 15:36959 (R;US)
Kramer, M.J., *See* Weir, S.T., 15:37255
Krause, G., *See* Grabemann, I., 15:37597
Kraushaar, J.J., *See* Clausen, B.L., 15:37854
Kreek, S.A., *See* Leyba, J.D., 15:37887
Kreitler, V.L., Variability in commercial markets and implications for program transferability, 15:37096 (RA;US)
Kress, R., *See* Jansen, J.F., 15:37373
Krishnan, H., *See* Shi, D., 15:37250
Kroeger, D.M., *See* Williams, R.K., 15:37355
Krueger, J., *See* Biney, P.O., 15:38172
Krzywicki, A., Stability of random surfaces, 15:37818 (J;US)
Ku, L.P., Design considerations for penetrations in the TFTR radiation shield, 15:38214 (RA;US)
Kubiak, G.D., X-ray lithography studies of polysilane using a laser plasma x-ray source, 15:37960 (BA;US)
Kuehl, H.H., Effects of higher-order dispersion on envelope solitons, 15:38054 (BA;US)
Kuhnert, A., *See* Becker, J.A., 15:37882
Kulcinski, G.L., *See* Emmert, G.A., 15:38163
See Sviatoslavsky, I.N., 15:38234
Kulenkampff, J., *See* Burkhardt, H., 15:36719

Kumada, Toshiaki, Problems of thermal engineering in target cooling, 15:37387 (RA;JP;In Japanese)
Kumar, A., Fabrication of minority-carrier-limited *n*-Si/insulator/metal diodes, 15:36842 (J;US)
In situ processing of textured superconducting thin film of Bi(-Pb)-Ca-Sr-Cu-O by excimer laser ablation, 15:37256 (J;US)
Kumar, P.A., *See* Henderson, S.D., 15:37825
Kume, Kenji, (p,π^-) reactions leading to the high-spin stretched 2p-1h states within the two-nucleon production model, 15:37906 (RA;JP;In Japanese)
Kunkel, W.B., *See* Purgalis, P., 15:38238
Kunkle, R., Case study analysis of the institutional buildings program in Washington State, 15:37090 (RA;US)
Kunszt, Z., *See* Ellis, S.D., 15:37802
Kunugi, Tomoaki, Numerical simulation of turbulent gas-particle fluid flow and heat transfer, 15:38120 (RA;US)
Kunz, P.F., Object oriented programming, 15:38333 (R;US)
See Atwood, W., 15:38334
Kunze, J., *See* Reaves, K., 15:37383
Kunzendorf, H., Geochemical criteria for reservoir quality variations in chalk from the North Sea, 15:36743 (R;DK)
Kuo, S.C., Thermal instability in current-carrying plasmas, 15:38083 (BA;US)
Kuo, S.P., Filamentation instability of MHD waves in solar wind plasma, 15:38055 (BA;US)
See Kuo, S.C., 15:38083
See Tiong, K.K., 15:38071
Kuo, T.T.S., *See* Jiang, M.F., 15:37913
Kuperin, Yu.A., Scattering theory for self-adjoint extensions, 15:37993 (R;SE)
Kupschus, P., Upgrading the JET pellet injector with a two-stage light gas gun prototype and future planning, 15:38203 (RA;US)
See Combs, S.K., 15:38225
Kurasov, P.B., *See* Kuperin, Yu.A., 15:37993
Kurihara, Kenichi, *See* Kawamata, Youichi, 15:38030
Kuriyama, M., Operation of JT-60NBI and NBI system for JT-60 upgrade, 15:38144 (RA;US)
Kuroda, T., Joint US/Japanese program of full-size building tests for base seismic isolation, 15:36958 (R;US)
See Kaneko, O., 15:38240
Kushima, T., *See* Horie, T., 15:38228
See Horiike, H., 15:38164
Kushler, M., Are high-participation residential conservation programs still feasible? The Santa Monica RCS model revisited, 15:37098 (RA;US)
Kushler, M.G., *See* Witte, P., 15:37050
Kushner, M.J., *See* McCaughey, M.J., 15:38084
See Weng, Y., 15:38298
Kussmaul, G., *See* Cahalan, J., 15:36955
Kutt, P.H., *See* Wuosmaa, A.H., 15:37864
Kwak, J.F., *See* Ginley, D.S., 15:37261
Kwan, J.W., *See* Purgalis, P., 15:38238
Kweller, E.R., Analysis of three measures for energy efficiency of residential gas furnaces, 15:37136 (BA;US)
Kwok, H., *See* Huang, Z.Q., 15:37541
Kwok, W.K., Shape of the upper-critical-field curves in URu_2Si_2: Evidence for anisotropic pairing, 15:37986 (J;US)

L

L'Homme, A., Presentation of the ressac research program (rehabilitation of soils and surfaces after an accident), 15:36952 (R;FR)
La Marche, P.H., *See* Martin, G.D., 15:38138
Ladd, A.J.C., *See* Meijer, E.J., 15:37365
Lagage, P.O., Acceleration and propagation of cosmic rays. Production, oscillation and detection of neutrinos, 15:37691 (R;FR;In French)
LaGattuta, K.J., Laser effects in photoionization. II. Numerical solution of coupled equations for atomic hydrogen, 15:37733 (J;US)
Lahdenperae, K., Eddy current inspection at the nuclear power plants, 15:37395 (R;FI;In Finnish)
Lahm, C.E., Consequences of metallic fuel-cladding liquid phase attack during over-temperature transient on fuel element lifetime, 15:36919 (R;US)
Laitner, S., Evaluating community energy management strategies using the options model, 15:37103 (RA;US)
Lakeman, C.D.E., *See* Schwartz, R.W., 15:37240
Lallemand, J.Y., Organic synthesis, 15:37346 (R;FR;In French)
LaMarche, P.H., Gas handling for the Tokamak Fusion Test Reactor during the DT phase of operation: System overview, 15:38136 (RA;US)
Lambert, J.F., Revisiting kaolinite dehydroxylation: A ^{29}Si and ^{27}Al MAS NMR study, 15:37177 (J;US)
Lambropoulos, P., *See* Tang, X., 15:37735
LaMora, R., *See* Dobeck, N., 15:37468
Lanan, S.G., *See* Shi, D., 15:37267
Landau, B., *See* Pezzimenti, D.M., 15:36775
Landen, O.L., *See* Kania, D.R., 15:37308
Landstrass, M.I., Total dose radiation hardness of diamond-based silicon-on-insulator structures, 15:37315 (J;US)
Lang, D., *See* Walthers, C., 15:38135
Lang, D.D., Microwave Tokamak Experiment: An overview of the construction and checkout phase, 15:38165 (RA;US)
Langford, J.E., *See* Halford, V.E., 15:36778
Langley, R.A., *See* Caughman, J.B.O. II, 15:38129
Langston, M.E., *See* Houlberg, L.M., 15:37013, 15:37014
Lannin, J.S., *See* Shao, W., 15:37326
Larsen, E., *See* Sviatoslavsky, I.N., 15:38234
Larsen, R.C., *See* Ohl, K.E., 15:37785
Larsen, R.P., Outlook for ceramics in heat engines, 1990–2010: A technical and economic assessment based on a worldwide Delphi survey, 15:37156 (R;US)
Larson, B.C., Time resolved techniques: An overview, 15:37538 (R;US)
Larson, D.J., *See* Hewett, D.W., 15:37503
Larson, E.M., *See* Lytle, F.W., 15:37221
See Radousky, H.B., 15:37275
Larson, H.A., *See* Rhodes, W.D., 15:36923
Larue, J., *See* Bogorinski, P., 15:36765
Lasnier, C., *See* Casper, T., 15:38276
Lassailly, Y., *See* Allen, J.W., 15:37271
Lassila, D.H., Material characteristics related to the fracture and particulation of electrodeposited-copper shaped charge jets, 15:37198 (R;US)
Laszlo, P., Fine chemistry, 15:37343 (R;FR;In French)
Latham, P. E., *See* Calame, J., 15:38069
Latham, P.E., The use of a single source to drive a binary peak power multiplier, 15:37479 (RA;US)
See Lawson, W., 15:37481
Laties, V.G., Magnetic fields and behavior: Annual performance report, 1989–1990, 15:37685 (R;US)
Lau, K.H., High-temperature equilibrium studies of the gaseous thorium chlorides, 15:37353 (J;US)
Laubereau, A., *See* Graener, H., 15:37356
Laval, G., Theoretical physics, 15:37989 (R;FR;In French)
Laval, J.P., Short-range order in the $Ca_{1-x}La_xF_{2+x}$ solid solution: 1:0:3 or 1:0:4 clusters?, 15:37171 (J;US)
Laville, F., *See* Tronc, E., 15:37165
Lavine, T.L., Transient analysis of multicavity klystrons, 15:37478 (RA;US)
Lawn, F., *See* Hatcher, R.E., 15:38191
Lawrence, D., *See* Michelsen, L., 15:37072
Lawson, J.E., TFTR neutral beam automated thermocouple monitor, 15:38246 (RA;US)
Lawson, W., Design considerations of high peak power gyroklystrons for linear colliders, 15:37481 (RA;US)
See Calame, J., 15:38069
See Granatstein, V.L., 15:37474
Lay, K.W., *See* Norton, D.P., 15:37249
Layter, J.G., *See* Daoudi, M., 15:37801
Le Bail, A., *See* Hemon, A., 15:37174
Le Duff, J., Advanced accelerator R & D at LAL/ORSAY, 15:37434 (RA;US)
Le Naour, F., *See* Olivera, J.J., 15:36910

Leal, L.C., Resonance analysis and evaluation of the ^{235}U neutron induced cross sections, 15:37886 (R;US)
Lebech, B., *See* Als-Nielsen, J., 15:37952
LeBlanc, W.J., Evaluating customer willingness to pay to avoid electric outages, 15:37066 (RA;US)
Leboeuf, J.N., *See* Carreras, B.A., 15:38016
Ledbetter, D.H., *See* Rich, D.C., 15:37641
Lee, A., Evaluation of DOE's [Department of Energy] resource-leveraging partnerships for low-income weatherization, 15:37056 (RA;US)
Residential energy efficiency and fuel choice, 15:37113 (RA;US)
Lee, A.T., *See* Young, B.A., 15:37317
Lee, C., *See* Alde, D.M., 15:37782
Lee, D.H., Binary-encounter electrons observed at 0° in collisions of 1–2-MeV/amu H^+, C^{6+}, N^{7+}, O^{8+}, and F^{9+} ions with H_2 and He targets, 15:37728 (J;US)
Lee, D.K., *See* Carreras, B.A., 15:38016
Lee, H.K., *See* Osborne, M.F., 15:36944
Lee, I-Yang, The GAMMASPHERE, 15:37515 (R;US)
Lee, I.Y., *See* Morsch, H.P., 15:37877
See Plasil, F., 15:37881
Lee, K.L., *See* Korellis, J.S., 15:37197
Lee, M., *See* Chen, Shiyi, 15:37740
Lee, M.J., Model-based expert systems for linac computer controls, 15:37471 (RA;US)
Lee, P.C.Y., Electromagnetic radiation from doubly rotated piezoelectric crystal plates vibrating at thickness frequencies, 15:37970 (J;US)
Lee, P.H.Y., *See* Casperson, D.E., 15:38296
Lee, R., *See* Hong, R., 15:38142
Lee, R.S., Generic initiation train for the fuzing: Revision 1, 15:37553 (R;US)
Lee, Shaoyung, Kinetics of oxidation of cobalt(II) macrocyclic complexes by tris(bipyridyl)ruthenium(3+) ion, 15:37349 (R;US)
Lee, W.W., *See* Sydora, R.D., 15:38089
Leemans, W., *See* Williams, R., 15:38056
Leenders, L., *See* Maerker, R.E., 15:36912
Leeper, R.J., New diagnostic developments for intense ion beam measurements on PBFA-2, 15:38040 (R;US)
See Woodworth, J.R., 15:38283
Leeper, S.A., Membrane process designs in the recovery of biofuels and bio-chemicals, 15:37150 (R;US)
Membrane technology applications in the food industry: Present and future, 15:37151 (R;US)
Legrand, B., *See* L'Homme, A., 15:36952
Lehmann, M., *See* Hastings, J.B., 15:37312
Lehnert, B., Diffusion-driven currents in a Z-pinch, 15:38051 (R;SE)
Lower pinch radius limit in EXTRAP, 15:38050 (R;SE)
Upper pinch radius limit in EXTRAP, 15:38049 (R;SE)
Lehto, W.K., *See* Hill, D.J., 15:36956
Leifeste, G.T., *See* Mazarakis, M.G., 15:37482
Leigh, J.R., *See* Lestone, J.P., 15:37884
Leipuner, L.B., *See* Ohl, K.E., 15:37785
Leis, B.N., Ductile fracture properties of selected line-pipe steels, 15:36747 (R;US)
Leitch, M.J., *See* Alde, D.M., 15:37782
Lejus, A.M., *See* Tronc, E., 15:37165
Lekov, A., *See* Subbarao, K., 15:37132
Lekov, A.B., Passive solar systems performance under conditions in Bulgaria, 15:36828 (R;US)
Leneman, D., *See* Simionovici, A., 15:37734
Leonard, M., Emergency operations procedures development and training, 15:38254 (RA;US)
Lepeltier, V., *See* Augustin, J.E., 15:37764, 15:37765
Lerman, D.I., An evaluation of the Bonneville Power Administration wood heat displacement program, 15:37048 (RA;US)
See Haeri, M.H., 15:37083
Leroux, B., *See* Boucheneb, N., 15:37892
See Carjan, N., 15:37891
LeSar, R.A., *See* Meijer, E.J., 15:37365
Lestone, J.P., Fission fragment angular distributions following transfer reactions for $^{232}Th + {}^{16}O$, 15:37884 (R;AU)
Lesueur, D., Studies on the irradiated solids, 15:37369 (R;FR;In French)
Leuer, J.A., Passive vertical stability of ITER (International Thermonuclear Experimental Reactor), 15:38013 (RA;US)
See Bathke, C.G., 15:38145
See Peng, Y.K.M., 15:38014
See Wong, C.P.C., 15:38154
Leung, L.K.H., *See* Cheng, S.C., 15:36913
Leung, Lam-Wing H., Adsorption and electrooxidation of some simple organic molecules on rhodium(111) as probed by real-time FTIR spectroscopy: Comparisons with platinum(111), 15:37219 (J;US)
Levin, A.E., Forced-to-natural convection transition tests in parallel simulated liquid metal reactor fuel assemblies, 15:36915 (R;US)
Levine, J.S., Phase-locking of multiple relativistic magnetrons, 15:38068 (BA;US)
Levine, M.B., *See* Sigmon, C.F., 15:36805
Levins, W.P., *See* Ternes, M.P., 15:37118
Levy, C.D.P., The laser system of the optically pumped ion source at TRIUMF, 15:37500 (R;CA)
Levy, M., *See* Zhang, Y., 15:37316
Lewi, J., Safety assessment for radiactive waste disposal, 15:36767 (R;FR;In French)
Sensitivity analysis concerning dose equivalents associated with the disposal of radioactive wastes in deep geological formations, 15:36769 (R;FR;In French)
Lewis, J.F., *See* Resnick, J., 15:38082
See Schwelberger, J., 15:38073
Lewis, M.B., *See* Caughman, J.B.O. II, 15:38129
Lewis, N.S., *See* Kumar, A., 15:36842
Ley, W.W., Vibrational pressure tuning spectroscopy of the polymethylene chain. 1. Various n-alkanes from C_8H_{18} to $C_{36}H_{74}$, 15:37360 (J;US)
Vibrational pressure tuning spectroscopy of the polymethylene chain. 2. Various polyethylenes, 15:37361 (J;US)
Leyba, J.D., Heavy actinide production from the interactions of ^{40}Ar with ^{248}Cm and a comparison with the ^{44}Ca-^{248}Cm system, 15:37887 (J;US)
Li Miao, Duality and modular invariance in rational conformal field theories, 15:37811 (R;DK)
Li, D.J., Trigonal phases in $YBa_2Cu_3O_{6.5}$, 15:37163 (J;US)
Li, F., *See* Shao, W., 15:37326
Li, G., Poloidal field electromagnetic engineering design for the TEXT upgrade, 15:38302 (BA;US)
Li, Q., Vibrational properties of percolating clusters: Localization and density of states, 15:37975 (J;US)
Li, W., *See* Zhang, H., 15:37277
Li, Y., Influence of anisotropy on the dispersion characteristics of guided ultrasonic plate modes, 15:37998 (J;US)
Three-dimensional random *XY* model: Application to the superfluid transition of ^4He in porous media, 15:37750 (J;US)
Li, Z., *See* Nicolis, N.G., 15:37871
Licina, G.J., Detection and control of microbiologically influenced corrosion: An extension of the sourcebook for microbiologically influenced corrosion in nuclear power plants, 15:36935 (R;US)
Liebsch, E.J., *See* Hunsaker, D.B. Jr., 15:36901
Lietzke, A.F., *See* Purgalis, P., 15:38238
Liew, S.L., *See* Ku, L.P., 15:38214
Lightner, M.J., *See* Chan, K.T., 15:37311
Lilienthal-Weber, Z., Schottky barrier contacts on defect-free GaAs (110), 15:37421 (J;US)
Lillberg, J.W., *See* Alde, D.M., 15:37782
Lin, C.D., *See* Fritsch, W., 15:37726
Lin, H., *See* Porter, L.E., 15:37935
Lin, M.S., *See* Premuzic, E.T., 15:36723
Lin, Y.P., *See* Selman, J.R., 15:37044
Lincoln, D.E., Herbivore responses to plants grown in enriched carbon dioxide atmospheres: Progress report, 15:37658 (R;US)
Lindberg, S.E., *See* Johnson, D.W., 15:37606
Lindemer, T.B., *See* Williams, R.K., 15:37355
Lindemuth, I.R., Evidence of hydrodynamic processes in multimegampere copper fuses, 15:38307 (J;US)
Lindgren, B., *See* Mayer, A., 15:37956
Lindgren, R.A., *See* Clausen, B.L., 15:37854
Lindholm, A., *See* Hakansson, A., 15:37859
Lineberry, J.T., *See* Winkleman, B.C., 15:37040

Ling, C.C., Activation of oncogenes by radon progeny and x-rays, 15:37665 (R;US)
Ling, Song, Effects of the transition dipole in Raman scattering, 15:37738 (J;US)
Linkins, A.E., Factors controlling decomposition in arctic tundra and related root mycorrhizal processes: [Progress report], 15:37635 (R;US)
Linteris, G.T., Hydroxyl radical concentration measurements in a turbulent flow reactor using a high temperature laser induced fluorescence probe, 15:37372 (BA;US)
Lippert, D.R., *See* Golf, F., 15:36864
Lisanttl, J., *See* Auble, R.L., 15:37889
Lissaman, P.B.S., Technical description of AVENU: A comprehensive computer software system for wind farm design, 15:36884 (BA;US)
Lissauer, D., *Z* dependence of Coulomb dissociation cross sections in heavy ion reactions, 15:37915 (J;US)
Little, S.N., Estimating nitrogen lost from forest floor during prescribed fires in Douglas-fir/western hemlock clearcuts, 15:37607 (J;US)
Littlejohn, D., Computer modeling of the chemistry of aqueous scrubber systems, 15:36900 (R;US)
Liu Bingren, *See* Zheng Hualing, 15:37367
Liu, J.Z., *See* McCarty, K.F., 15:37266
Liu, S.N., *See* Avioli, M.J. Jr., 15:36934
Liu, Y.Y., Whole-Pin Furnace system: An experimental facility for studying irradiated fuel pin behavior under potential reactor accident conditions, 15:36961 (R;US)
Livengood, C.D., Use of ferrous chelates for NO_x control in aqueous scrubbers, 15:36707 (R;US)
See Huang, H., 15:36892
Liverman, W.J., *See* Huber, J.G., 15:37264
Livingston, A.B., Physics Division progress report for period ending September 30, 1989, 15:37836 (R;US)
Livolant, M., Advances on the analysis of fast reactor core and coolant circuit structures, 15:36996 (BA;US)
Ljungfelt, S., *See* Bosshard, A., 15:37784
Lleres, A., Influence of the mass asymmetry of the entrance channel on incomplete fusion processes, 15:37894 (R;FR)
Lochner, T.R., *See* Woodworth, J.R., 15:38283
Lochter, M., *See* Euringer, H., 15:38143
Locke, T.M, *See* Miranda, A.S., 15:38320
Lockner, T.R., *See* Bieg, K.W., 15:38261
Lockridge, J.E., New selective anion-exchange resins for nitrate removal from contaminated drinking water and studies on analytical anion-exchange chromatography, 15:37616 (R;US)
Loehle, C., A guide to increased creativity in research inspiration or perspiration, 15:37023 (J;US)
Constraints on tree breeding: Growth tradeoffs, growth strategies, and defensive investments, 15:37610 (J;US)
Loeppke, G.E., *See* Glowka, D.A., 15:36871
Loesser, G.D., *See* Barnes, G.W., 15:38147
Loevestam, Goeran, Development of a scanning proton microprobe - computer-control, elemental mapping and applications, 15:37333 (R;SE)
Loewenhaupt, M., Magnetic excitations in USn_3, 15:37222 (J;US)
Lof, G.O.G., *See* Davidson, J.H., 15:36858
Lofftus, D.A., *See* Hart, A.T., 15:37039
Loh, E.Y. Jr., Sign problem in the numerical simulation of many-electron systems, 15:38006 (J;US)
Lomas, P., *See* Tanga, A., 15:38012
Lomdahl, P.S., *See* Falo, F., 15:37984
Lomperski, S., *See* Biney, P.O., 15:38172
Longhurst, G.R., Uranium storage bed accident hazards evaluation, 15:38107 (RA;US)
Lontai, L., *See* McDade, J., 15:38241
Loong, C., *See* Loewenhaupt, M., 15:37222
Lorber, K.E., Emission and biological activity of N-containing polycyclic aromatic compound as exhaust of Diesel engines, 15:37158 (R;DE;In German)
Lorenz, R.A., *See* Osborne, M.F., 15:36944
Loring, M., First tests of the Varian EIMAC X2242 at 110 and 130 MHz in the JT-60 ICRH system, 15:38252 (RA;US)
Loubriel, G.M., *See* Zutavern, F.J., 15:37410
Lovell, E., *See* Sviatoslavsky, I.N., 15:38234
Lovell, T.W., Design and initial operation of the Madison Symmetric Torus, 15:38284 (BA;US)
Loveman, R.A., *See* Clausen, B.L., 15:37854
Low, S.R. III, *See* Naus, D.J., 15:36995
Lowndes, D.H., *See* Christen, D.K., 15:37228
See Norton, D.P., 15:37249
Lowry, C., *See* Tanga, A., 15:38012
Lu Zhaoyang, *See* Geng Yongjian, 15:37664
Lu, E., *See* Hatcher, R.E., 15:38191
Lu, Kang, *See* Reaves, K., 15:37383
Lu, Po-Yung, [Health risk assessment on environmental, occupational, and life style hazards]: Foreign trip report, December 12–30, 1988, 15:37675 (R;US)
Lubensky, T.C., *See* Golubovic, L., 15:37746
Lucero, A.J., *See* Wilson, J.H., 15:37612
Lucey, R.F., *See* Miller, J.D., 15:38281
Luera, T.F., Simulation fidelity in reactor irradiation of electronics, 15:37407 (R;US)
Lueth, V., *See* Jacobsen, R., 15:37534
Lui, D.W., *See* Fang, J.M., 15:37080
Luke, G.M., *See* Sternlieb, B.J., 15:37268
Lundell, A.T., Explicit construction of nontrivial elements for homotopy groups of classical Lie groups, 15:37995 (J;US)
Lusignan, C.P., *See* Gao, Y., 15:37322
Luth, V., *See* Alexander, J., 15:37799
Luther, G.G., Transverse modulational instability of collinear waves, 15:38304 (J;US)
Lutsko, J.F., *See* Phillpot, S.R., 15:37321
Luxon, J.L., *See* Kim, Jinchoon, 15:38118
Lyles, B.F., NTS [Nevada Test Site] Mesa recharge study FY 1988: Letter report, 15:37615 (R;US)
Lynch, T.P., *See* Rasnake, D.G., 15:37041
Lynch, V.E., *See* Carreras, B.A., 15:38016, 15:38018
Lynn, J.W., *See* Zhang, H., 15:37277
Lynn, K.G., *See* Henderson, S.D., 15:37825
Lyon, R.E., Safety analysis of the Compact Ignition Tokamak (CIT) release of activated solid material, 15:38247 (RA;US)
See Campbell, J.H., 15:37413
See Fleming, R.B., 15:38182
See Wolfe, C.R., 15:37304
Lysne, P.C., *See* Glowka, D.A., 15:36871
Lytle, F.W., Determination of the valence of Pr, Gd, and Ho in $YBa_2Cu_3O_7$ by x-ray absorption spectroscopy, 15:37221 (J;US)

M

Ma, X., Multimode squeeze operators and squeezed states, 15:38003 (J;US)
MacCrone, R.K., *See* Nettel, S.J., 15:37269
MacDonald, J.M., *See* Sharp, T.R., 15:37121
MacDowall, R.D., Engineering evaluation testing of the Soleq Dual Battery Van, 15:37157 (R;US)
MacFarlane, J., *See* Sviatoslavsky, I.N., 15:38234
Machi, Sueo, Proceedings of the international symposium on radiation vulcanization of natural rubber latex, 15:36817 (R;JP)
Machleidt, R., *See* Jiang, M.F., 15:37913
Mackiln, W.J., On the use of oxides for thermoelectric refrigeration, 15:37042 (R;GB)
Macmillan, J.D., *See* Eveleigh, D.E., 15:37632, 15:37633
Madan, B., Diffusion in supercooled liquids via normal mode analysis, 15:37364 (J;US)
Madsen, J.O., The β-function in 4-dimensional topological Yang-Mills theory, 15:37810 (R;DK)
Maeda, Yutaka, *See* Utsuro, Masahiko, 15:36948
Maenchen, J., *See* Leeper, R.J., 15:38040
Maenchen, J.E., *See* Woodworth, J.R., 15:38283
Maerker, R.E., Analysis of the VENUS-3 experiments, 15:36912 (R;US)
Parameter and fluence-rate covariances in lepricon, 15:36911 (R;US)
Maez, M.A., *See* Cooke, D.W., 15:37259
Magnotta, F., *See* Mapoles, E.R., 15:37974
Mah, E., *See* Di Domenico, P., 15:36969

Mahan, A.H., Microvoids and photoconductivities in a-SiC:H and a-Si:H, 15:37306 (BA;US)
Mahnke, R.B., *See* Szlyk, P.C., 15:37558
Maier, W.B., *See* Kadish, A., 15:38086
Maier, W.B. II, *See* Kadish, A., 15:38094
Maier-Reiter, W., Changes in terrestrial ecosystems after long-term exposure to airborne pollutants - studies on the effects of ozone and NO_x immissions on spontaneous vegetation. Final report, 15:37681 (R;DE;In German)
Majeski, R., *See* Brouchous, D., 15:38087
Majka, Z., *See* Nicolis, N.G., 15:37871
Major, R.W., *See* Modine, F.A., 15:37252
Makarov, K.A., *See* Kuperin, Yu.A., 15:37993
Malinovic, B., Simulation of Phases 3 and 4 of the TMI-2 accident using MAAP-DOE and MAAP 3.0B, Task 3.9, 15:36964 (R;US)
Mallouk, T.E., *See* Bard, A.J., 15:37291
Maltman, K., Nuclear charge symmetry breaking and quantum-chromodynamically-induced corrections to quantum electrodynamics, 15:37917 (J;US)
Mamantov, G., *See* Hembree, D.M., 15:38007
Mane, F., *See* Augustin, J.E., 15:37764, 15:37765
Mangan, D.L., *See* Drayer, D.D., 15:36814
Mangano, M., *See* Parke, S., 15:37813
Mangin, J.P., *See* Brun-Yaba, C., 15:36768
Manheimer, W.M., *See* Gold, S.H., 15:38279
Mankofsky, A., *See* Friedman, A., 15:38067
Mann, G.A., *See* Harjes, H.C., 15:37411
Mann, M.E., *See* Ceder, G., 15:37263
Mann, W.R., *See* Thome, R.J., 15:38096
Mannelli, E.B., *See* Ohl, K.E., 15:37785
Manns, W., *See* Kim, Kyekyoon, 15:38212
Mansfield, D.K., *See* Synakowski, E.J., 15:38034
Mansfield, M.A., Synthesis of the low molecular weight heat shock proteins in plants, 15:37672 (J;US)
Mansur, L.K., [Radiation materials science in the Soviet Union]: Foreign trip report, May 19–31, 1990, 15:37290 (R;US)
Mantz, H.C., A carbon-carbon panel design concept for the inboard limiter of the Compact Ignition Tokamak (CIT), 15:38132 (RA;US)
Mao Zijun, *See* Geng Yongjian, 15:37664
Maple, M.B., *See* Allen, J.W., 15:37271
See Bjornholm, T., 15:37276
See Weir, S.T., 15:37255
Mapoles, E.R., Optical pulses in tritiated solid hydrogen, 15:37974 (J;US)
Marchi, F.T., *See* Wolfe, C.R., 15:37244
Marcos, J., *See* Klier, K., 15:37341
Marek, M.J., *See* Rhodes, B.A., 15:37646
Marella, P.F., Flashlamp-pumped dye and excimer laser planarization of thin metal films, 15:37957 (BA;US)
Margolis, S.B., Stability of homogeneous-solid deflagration with two-phase flow in the reaction zone, 15:37390 (J;US)
Marin, I., *See* Sanz, J.L., 15:37638
Mark, J.W.K., *See* Friedman, A., 15:38067
Markee, N.L., Limited-income elderly: Implications for program design and implementation, 15:37109 (RA;US)
Markely, F.W., Investigation of the mechanical properties of superconducting coils, 15:37405 (R;US)
Markham, J.R., *See* Solomon, P.R., 15:36716
Marks, L.D., *See* Li, D.J., 15:37163
Marland, G., *See* Hunsaker, D.B. Jr., 15:36901
Marques-Bonham, S., The Dirac equation in a non-Riemannian manifold: II. An analysis using an internal local *n*-dimensional space of the Yang–Mills type, 15:37814 (J;US)
Marra, A., *See* Andreani, R., 15:38160
Marsh, G.C., *See* Williams, R.K., 15:37355
Marsh, K., *See* Williams, R., 15:38056
Marshall, A.F., *See* Chang, Y., 15:37310
Martell, P.J., It's not hype, it's communication: Using public relations techniques to improve your technical messages, 15:38344 (R;US)
Martin, A.D., *See* Harriman, P.N., 15:37789
Martin, D., *See* Altmann, H., 15:38131
Martin, G.D., The use of cryopumps for impurity pumping during the TFTR D-T phase, 15:38138 (RA;US)
See Fleming, R.B., 15:38182
See LaMarche, P.H., 15:38136
Martin, J.E., Fast aggregation of colloidal silica, 15:37318 (J;US)
See Adolf, D., 15:37294
Martin, M.A., *See* Bayes, D.V., 15:38112
Martin, M.M., *See* Cooper, R.H., 15:37043
Martin, R.C., *See* Wong, C.P.C., 15:38154
Martin, S., *See* Bonner, B.P., 15:37278
martin, S.J., *See* Frye, G.G., 15:37238
Martinelli, L., *See* Goff, S., 15:36863
Martinez, F., *See* Schrage, D., 15:37431
Martinez, L., *See* Harjes, H.C., 15:37411
Martinis, L., A new two-stage pellet injector for FTU, 15:38198 (RA;US)
Maruyama, Koichi, Recent photoreaction experiments at 1.3 GeV Tokyo ES, 15:37843 (RA;JP)
Maruyama, Masahiro, A study on low-energy proton-antiproton pair annihilation by means of planar quark diagram picture, 15:37791 (RA;JP;In Japanese)
Masaike, Akira, Some issues in elementary particle physics involving low-energy neutrons and antiprotons focusing on measurement of violated symmetry, 15:37792 (RA;JP;In Japanese)
Maschio, A., *See* Benfatto, I., 15:38221
See De Lorenzi, A., 15:38205
Mason, D.M., *See* Carty, R.H., 15:36693
Massmann, P., Pumping of gaseous helium using argon frosted liquid helium cryo-condensation pumps, 15:38180 (RA;US)
Massot, M., *See* Fusco, F.A., 15:37303
Mastin, G.A., *See* Sanford, T.W.L., 15:37445
Masuda, K., *See* Kaneko, O., 15:38240
Masuda, Yasuhiro, *See* Adachi, Toshikazu, 15:37898
Mathews, G.J., *See* Alcock, C.R., 15:37804
See Sale, K.E., 15:37856
Mathey, F., The phosphorus and the transition metals chemistry, 15:37345 (R;FR;In French)
Matsuda, S., *See* Koizumi, K., 15:38178
Matsuda, Y., *See* Mizuno, K., 15:38079
Matsuda, Yuji, *See* Naruse, Yuji, 15:38106
Matsukawa, M., *See* Horie, T., 15:38228
See Horiike, H., 15:38164
Matsuoka, Nobuyuki, Production of 7 meson by p+d→^{3}He+7 reaction at the near threshold, 15:37902 (RA;JP;In Japanese)
Mattern, L.J., *See* Hertzer, D.R., 15:36799
Matthews, J., *See* Jacobsen, R., 15:37534
Matthews, T.G., Impact of heating and air conditioning system operation and leakage on ventilation and intercompartment transport: Studies in unoccupied and occupied Tennessee Valley homes, 15:37137 (J;US)
Mattison, E.M., *See* Walsworth, R.L., 15:37722
Mattson, J., *See* Moreau, A., 15:37207
Mattson, J.S. Jr., Controlled eager evaluation in a Dynamic-Arc Tagged-Token Dataflow Model, 15:38336 (R;US)
Matuk, C.A., *See* Purgalis, P., 15:38238
Mau, T.K., *See* Santarius, J.F., 15:38155
Maurel, M., *See* Lleres, A., 15:37894
Max, N.L., Computer animation in mathematics, science and art, 15:38340 (R;US)
Maxwell, E., *See* Riordan, C., 15:36827
Maxwell, R.L., *See* Holmes, J.P., 15:38346
Mayer, A., A TDC-PC based DPAC spectrometer, 15:37956 (R;SE)
Mazarakis, M.G., The new injector design for the upgraded RADLAC-II linear accelerator, 15:37482 (RA;US)
Mazria, E., Architectural integration: Residential and light commercial buildings, 15:36854 (BA;US)
Mazumdar, P., *See* Bates, J.B., 15:37247
McAllister, L., *See* Wolfe, P., 15:37062
McArthur, R.D., Off-Site Radiation Exposure Review Project: Phase 2 soils program: Revision, 15:37596 (R;US)
McAtee, W.H., *See* Sanford, T.W.L., 15:37445
McBee, M.R., Advanced Neutron Source (ANS) Project progress report, 15:36818 (R;US)
McCamy, J.W., *See* Norton, D.P., 15:37249
McCarthy, J.F., Biological (molecular and cellular) markers of toxicity: Semi-annual technical progress report No. 3, October 1, 1989–March 31, 1990, 15:37677 (R;US)

Determination of the order of phase transitions in numerical simulations, 15:37972 (J;US)
McCarthy, P., *See* Kupschus, P., 15:38203
McCarty, K.F., Raman-active phonons of a twin-free $YBa_2Cu_3O_7$ crystal: A complete polarization analysis, 15:37266 (J;US)
Superconducting La_2CuO_{4+x} prepared by oxygenation at high pressure: A Raman scattering study, 15:37242 (R;US)
McCaughey, M.J., Electron swarms in two phase plasmas, 15:38084 (BA;US)
McCorkle, S., *See* Henderson, S.D., 15:37825
McCormack, B., *See* Dahlgren, F., 15:38186
See Lawson, J.E., 15:38246
McCrory, F.M., Annular core research reactor high flux neutron radiography facility, 15:36949 (R;US)
McDade, J., TFTR neutral beam bellows redesign and calorimeter upgrade, 15:38241 (RA;US)
McDaniel, D.H., *See* Rochau, G.E., 15:38263
McDaniel, E.W., [Nuclear waste management]: Foreign trip report, October 6, 1988–November 6, 1988, 15:36781 (R;US)
[Waste immobilization technology]: Foreign trip report, March 16–April 8, 1988, 15:36780 (R;US)
McDonough, J., *See* Henderson, S.D., 15:37825
McElhaney, S.A., Two-dimensional position-sensitive detectors for small-angle neutron scattering, 15:37530 (R;US)
McElroy, D.L., Chlorofluorocarbon (CFC) technologies review of foamed-board insulation for buildings, 15:37123 (R;US)
See Fine, H.A., 15:37124
McEntee, J., *See* Chen, G., 15:37145
McGaughey, P.L., *See* Alde, D.M., 15:37782
McGinn, P.J., *See* Shi, D., 15:37250
McGowan, F.K., *See* Sarantites, D.G., 15:37865
McGuigan, M., Constraints for toroidal cosmology, 15:37702 (J;US)
McKay, D.M., *See* Kim, D.H., 15:37279
McKay, M.D., *See* Beckman, R.J., 15:37377
McKeegan, K.D., *See* Radousky, H.B., 15:37275
McKellar, B.J., Service quality study: Wisconsin Power and Light Company, 15:37073 (RA;US)
McKibben, M.A., [Sulfide-oxide-silicate phase equilibria and associated fluid inclusion properties in the Salton Sea geothermal system, California]: Final technical report, September 1, 1985–February 1, 1988, 15:36873 (R;US)
McKinnel, T.A., *See* Van Liere, K.D., 15:37110
McKinnell, T., *See* McKellar, B.J., 15:37073
McKinney, S.M., *See* Schmidt, J.W., 15:37624
McKinstrie, C.J., *See* Luther, G.G., 15:38304
McKone, T.E., Uncertainty in exposure and health-risk assessment: An integrated approach, 15:37623 (R;US)
McLain, H.A., A steam dispatching control system for Fort Benjamin Harrison, Indiana, 15:37135 (BA;US)
McLaren, R.A., *See* Hawthorne, J.E., 15:37547
McLaughlin, D.L., *See* Zutavern, F.J., 15:37410
McLean, R.B., *See* Hunsaker, D.B. Jr., 15:36901
McLeod, K.W., *See* Donovan, L.A., 15:37628
McLuckey, S.A., *See* Van Berkel, G.J., 15:36721
McMahon, J.E., Enactment of federal energy efficiency standards for residential appliances, 15:37131 (BA;US)
McNamara, N., *See* Struckmeyer, R., 15:36973
McNeil, E., *See* Schuck, L., 15:37075
McNeil, J.A., *See* Cecil, F.E., 15:37848
McVeety, B.D., *See* Cataldo, D.A., 15:37687
McWhorter, P.J., *See* Miller, S.L., 15:37424
Means, K.H., *See* Clark, N.N., 15:36704
Medica, P.A., *See* Esque, T.C., 15:37595
Medina, V., *See* Adams, A., 15:36862
Medina, W., *See* Diaz, F.A., 15:37589
Medley, S.S., *See* Roquemore, A.L., 15:38074
Mehlhorn, T.A., *See* Prestwich, K.R., 15:38262
See Woodworth, J.R., 15:38283
Mehosky, B.L., *See* Boecker, W.D., 15:37237
Meier, K.L., *See* Tallerico, P.J., 15:37473
Meier, W.R., A plan for the study of the costs and environmental impact of fusion compared with alternative energy sources: Final report, 15:38274 (R;US)
See Tobin, M.T., 15:38223
Meijer, E.J., Location of melting point at 300 K of nitrogen by Monte Carlo simulation, 15:37365 (J;US)
Meijer, S., *See* Ronsten, G., 15:36878
Meinzer, F.C., *See* Sharifi, M.R., 15:37611
Meisenheimer, R.G., *See* Radousky, H.B., 15:37275
Meiss, J.D., *See* Kook, H., 15:38001
Meissner, R., *See* Burkhardt, H., 15:36719
Mejon-Goula, M.J., *See* Lewi, J., 15:36769
Mellus, C.F., *See* Bergan, N.E., 15:36741
Melnikov, Yu. B., *See* Kuperin, Yu.A., 15:37993
Melo, P.F.F., *See* Oliveira, L.F., 15:37385
Mendel, C.W. Jr., *See* Rochau, G.E., 15:38263
Mendelsohn, M.H., Enhanced flue gas denitrification using ferrous EDTA and a polyphenolic compound having combined antioxidant and reducing properties, 15:36706 (R;US)
See Livengood, C.D., 15:36707
Menyuk, C., *See* Chen, C., 15:37540
Merrill, B.J., Safety implications of a graphite oxidation accident in the Compact Ignition Tokamak device, 15:38248 (RA;US)
See O'Brien, M.H., 15:38257
Mertzbacher, C.I., *See* Radousky, H.B., 15:37275
Messenger, M., *See* Warner, K.L., 15:37111
Mestayer, M.D., *See* Bortoletto, D., 15:37781
Meublat, L., Synthesis and characterization of ruthenium fluorides and oxide fluorides with high oxidation states, 15:37347 (R;FR;In French)
Meuth, H., *See* Eylon, S., 15:38297
Meyer, B.S., *See* Alcock, C.R., 15:37804
See Howard, W.M., 15:37696
Meyer, H., *See* Goodwin, J.E., 15:37463
Meyer, J., High energy nuclear physics, 15:37751 (R;FR;In French)
Meyer, R.A., Mixed-symmetry states in ^{144}Nd: Semimicroscopic accounting within the cluster vibration model and its mapping into the interacting boson model, 15:37914 (J;US)
Meyer, W., *See* Casper, T., 15:38276
Meyer, W.H., *See* Butner, D.N., 15:38053
Michelsen, L., An evaluation of central Maine Power Company's pilot water heater cycling program, 15:37072 (RA;US)
See Ecker, L.K., 15:37049
Mighell, A.D., *See* Carr, M.J., 15:38347
Migliori, S., *See* Cecchini, A., 15:38124
See Martinis, L., 15:38198
Mihelich, J.W., *See* Kaczarowski, R., 15:37878
Mihevc, T.M., *See* Lyles, B.F., 15:37615
Mikkelson, J.E., *See* Rinehart, L.F., 15:37408
Miknis, F.P., Thermal decomposition of DOE reference oil shales, 15:36758 (J;US)
See Chong, S.L., 15:36756
Milanovich, F.P., *See* Angel, S.M., 15:37298
Miles, K.J., *See* Tentner, A.M., 15:36918
Miley, G., *See* Montalvo, E., 15:38011
Miley, G.H., *See* Hu, S., 15:38291
See Williams, W.H., 15:37720
Miller, D., *See* Shi, D.. 15:37250
Miller, D.C., The reactivity of the thioalkyne, MeSC≡CSMe, with ruthenium and tungsten complexes, 15:37351 (R;US)
Miller, D.G., Equal eigenvalues in multicomponent diffusion: The extraction of diffusion coefficients from experimental data in ternary systems, 15:37955 (R;US)
Miller, F.L. Jr., *See* McArthur, R.D., 15:37596
Miller, G., *See* Palmrose, D.E., 15:38295
See Weber, P.G., 15:38063
Miller, G.A., Multidimensional radiation analysis for the fusion ignition experiment IGNITEX, 15:38215 (RA;US)
Miller, J.C., [Multiphoton spectroscopy of molecules]: Foreign trip report, May 16, 1988–June 1, 1988, 15:37714 (R;US)
Miller, J.D., Ion channel transport systems for high current electron beam accelerators, 15:38281 (BA;US)
See Gilgenbach, R.M., 15:38072
Miller, J.E., *See* Harrison, F.L., 15:37682
Miller, J.R., Evaluation of the Utah Institutional Conservation Program: Preliminary results, 15:37089 (RA;US)
Miller, M.C., Pixar data visualization tools overview, 15:38335 (R;US)
Miller, P.E., *See* Tiong, K.K., 15:38071

Miller, R., *See* Price, D., 15:37556
Miller, R.A., Assessment of fundamental materials needs for thick thermal barrier coatings (TTBC's) for truck diesel engines, 15:37230 (R;US)
Miller, R.H., *See* Lavine, T.L., 15:37478
Miller, R.L., The ARIES-I high-field-tokamak reactor: Design-point determination and parametric studies, 15:38152 (RA;US)
See Bartlit, J.R., 15:38151
See Hunsaker, D.B. Jr., 15:36901
See Sze, D.K., 15:38153
Miller, S., *See* Calame, J., 15:38069
Miller, S.L., Effect of temperature on data retention of silicon-oxide-nitride-oxide-semiconductor nonvolatile memory transistors, 15:37424 (J;US)
Millman, W.S., *See* Lambert, J.F., 15:37177
Milonni, P.W., *See* Goggin, M.E., 15:38005
Milora, S.L., *See* Combs, S.K., 15:38225
See Fisher, P.W., 15:38196
See Gouge, M.J., 15:38197, 15:38204
Minami, M., *See* Onozuka, M., 15:38200
Mines, G.L., *See* Bliem, C.J., 15:36868
Ming, C., *See* Ronsten, G., 15:36878
Minty, M.G., *See* Goodwin, J.E., 15:37463
Miranda, A.S., OMNI development of an engineering product data management system, 15:38320 (R;US)
Miranda, R., Mechanism of hydrodenitrogenation: Part 1, Preparation and characterization of acidic supports, 15:36696 (R;US)
Mirizzi, F., *See* Andreani, R., 15:38160
Misaizu, F., Dissociation dynamics and multiphoton ionization mechanism of ammonia clusters, 15:37357 (J;US)
Mischke, R.E., Low-mass, high-rate cylindrical MWPC's for the MEGA experiment, 15:37526 (R;US)
Mishra, C.S., Dilepton and dihadron production in proton-nucleus collisions at 800 GeV, 15:37759 (R;US)
See Alde, D.M., 15:37782
Mitarai, O., *See* Yoshikawa, K., 15:38224
Mitchell, M.A., *See* Ginley, D.S., 15:37261
Mitchell, R.A., STL [Simulation Technology Laboratory] Global Control System, technical reference, 15:37499 (R;US)
Mitchell, T.J., [Optimal design and analysis of experiments]: Foreign trip report, July 16–August 5, 1988, 15:38324 (R;US)
Mixon, W.W., *See* Terry, D.R., 15:38242
Mizuno, K., Experimental design of spectroscopic measurements of microwave electric field in MTX tokamak plasma, 15:38079 (BA;US)
Ion acoustic decay instabilities in laser pellet interactions, 15:38057 (BA;US)
Measurements of laser wavelength scaling ion acoustic decay instability and associated effects in laser-plasma interaction experiments: Final report, 15:38256 (R;US)
See Oda, T., 15:38052
Mock, R.C., *See* Sanford, T.W.L., 15:37445
Modine, F.A., Polarization currents in varistors, 15:37252 (J;US)
Pulse response characteristics of ZnO varistors, 15:37262 (J;US)
Modro, S.M., The LP-FP-2 severe fuel damage scenario and discussion of the relative influence of the transient and reflood phases in affecting the final condition of the bundle, 15:36971 (R;US)
See Fell, J., 15:36983
Moed, B.A., *See* Turk, B.H., 15:37591
Moeny, W.M., *See* Rodriguez, A.E., 15:38066
Moerig, R., *See* Burkhardt, H., 15:36719
Moffat, D., *See* Padamsee, H., 15:37470
Mohanti, R., *See* Gilligan, J., 15:38277
Mohr, C.M., *See* Leeper, S.A., 15:37151
Mollenhauer, K., *See* Lorber, K.E., 15:37158
Moller, J., *See* Casper, T., 15:38276
Moller, J.M., *See* Butner, D.N., 15:38053
Monar, K.P., *See* Matthews, T.G., 15:37137
Mondelli, A., *See* Chernin, D., 15:37439
See Granatstein, V.L., 15:37474
Moneti, G.C., *See* Bortoletto, D., 15:37781
Monien, H., Spin and charge excitations in $YBa_2Cu_3O_7$: Constraints from spin-relaxation rates in the normal state, 15:37274 (J;US)
Monsler, M.J., *See* Meier, W.R., 15:38274
Montalvo, E., Analysis of the poloidal field system leads in the IGNITEX experiment, 15:38116 (RA;US)
Analysis of the small and large versions of the IGNITEX experiment, 15:38193 (RA;US)
Fusion physics study of the IGNITEX experiment, 15:38011 (RA;US)
See Dong, J.Q., 15:38008
Montgomery, B.H., *See* Levin, A.E., 15:36915
Montgomery, D.B., *See* Reiersen, W.T., 15:38194
Montgomery, D.C., Nonlinear magneto-hydrodynamics: Progress report, January 1, 1989–June 30, 1990, 15:38021 (R;US)
Montgomery, R.O., *See* Billone, M.C., 15:36997
Moodenbaugh, A.R., *See* Huber, J.G., 15:37264
Moon, F.C., Materials research issues in superconducting levitation and suspension as applied to magnetic bearings, 15:37227 (R;US)
Moon, P.K., Intrinsic fast oxygen ionic conductivity in the $Gd_2(Zr_xTi_{1-x})_2O_7$ and $Y_2(Zr_xTi_{1-x})_2O_7$ pyrochlore systems, 15:37246 (BA;US)
Moore, M., *See* Bayley, S.E., 15:36788
Moore, R.L., *See* Siefken, L.J., 15:36967
Moore, W.B.S., *See* Rochau, G.E., 15:38263
Moreau, A., New measurements of the elastic properties of composition modulated Cu-Ni thin films, 15:37207 (J;US)
Moreau, J., *See* Cahalan, J., 15:36955
Morelli, F., *See* Cecchini, A., 15:38124
Morency, J.R., *See* Parker, T.E., 15:36742
Moreno, J.B., *See* Andraka, C.E., 15:36847
See Diver, R.B., 15:36859
Moreno, J.C., Identification of hydrogenlike and heliumlike transitions in the spectrum of laser-produced magnesium plasmas, 15:37414 (J;US)
Morgan, A.J., *See* Wolfe, C.R., 15:38272
Morgan, F.A., *See* Harjes, H.C., 15:37411
Morgan, M.A., Experimental and simulation studies of collisionless plasma flow, 15:38278 (BA;US)
Mori, W.B., *See* Williams, R., 15:38056
Mori, Yoshiharu, Polarized 3He gas target, 15:37844 (RA;JP;In Japanese)
Morikawa, Yoshitomi, Interference experiment and analysis of neutron wave packet, 15:37925 (RA;JP;In Japanese)
Morimoto, Kimio, *See* Adachi, Toshikazu, 15:37898
Morinobu, S., *See* Yosoi, M., 15:37532
Morita, Yoshiyuki, *See* Kawai, Takeshi, 15:37928
Moriyama, S., First JT-60 system high power 110 to 130 MHz test results with an X2242 tetrode, 15:38236 (RA;US)
See Loring, M., 15:38252
Morman, J.A., Tomographic imaging of severely disrupted fuel assemblies tested in TREAT, 15:36916 (R;US)
Morosin, B., *See* Ginley, D.S., 15:37261
See Venturini, E.L., 15:37258
Morris, D.E., *See* Zhang, H., 15:37277
Morris, G.J., A large amplitude oscillating combustor, 15:36715 (BA;US)
Morris, J., *See* Karr, T., 15:37742
Morris, M.D., [Optimal design and analysis of experiments]: Foreign trip report, July 22–29, 1988, 15:38323 (R;US)
Morris, V., *See* Walker, G.A., 15:37593
Morsch, H.P., Thermal and angular momentum effects in the giant-dipole-resonance decay of hot rare-earth nuclei, 15:37877 (J;US)
Morton, P.L., *See* Lavine, T.L., 15:37478
Moseley, P.T., *See* Macklin, W.J., 15:37042
Moses, G.A., *See* Sviatoslavsky, I.N., 15:38234
Moses, J.D., *See* Baumgart, C.W., 15:37402
Moss, T.A., *See* Diver, R.B., 15:36859
Mott, J.E., *See* King, R.W., 15:36917
Motyka, T., Advanced hydride laboratory, 15:36820 (BA;US)
Mouat, M., *See* Levy, C.D.P., 15:37500
Mours, B., *See* Atwood, W., 15:38334
Mowrer, G.R., *See* Rochau, G.E., 15:38263
Moy, C.A., *See* Arimilli, R.V., 15:37000
Mrig, L., Stability, performance and trend modeling of amorphous silicon photovoltaic modules, 15:36840 (BA;US)
Mudge, L.K., *See* Van Tuyl, H.H., 15:36815

Mueller, J., Regular and chaotic motion of classical electrons in the wake potential of fast ions in solids, 15:37933 (J;US)
Semiclassical eigenenergies in the wake of fast ions in solids, 15:37943 (R;US)
See Spampinato, P.T., 15:38159
Mueller, T.R., Program for preparing output data from a flow injection spectrometer for entry into AnaLis data base of the Analytical Chemistry Division, Oak Ridge National Laboratory, 15:37335 (R;US)
Muir, P.F., A virtual sensor approach to robot kinematic identification: Theory and experimental implementation, 15:37378 (R;US)
Mukoyama, Takeshi, Inverse internal conversion processes, 15:37719 (RA;JP;In Japanese)
Mulholland, G.P., *See* Ghanbari, C.M., 15:36849
Munkegaard, J., *See* Hopper, R.J., 15:36745
Munro, N.B., *See* Watson, A.P., 15:37561
Munson, C.P., *See* Weber, P.G., 15:38063
Murakami, T., *See* Sternlieb, B.J., 15:37268
Murata, K.K., Recent developments in the CONTAIN-LMR code, 15:36987 (R;US)
Murdock, B., *See* Kelly, J.J., 15:37857
Murnane, M.M., X-ray streak camera with 2 ps response, 15:37544 (J;US)
Murphy, B.D., *See* Becraft, W.R., 15:37432
Murr, L.E., Effects of deformation (strain) and heat treatment on grain boundary sensitization and precipitation in austenitic stainless steels, 15:37203 (J;US)
Murray, C.I., *See* Markee, N.L., 15:37109
Murray, D.W., Selecting appropriate test targets for portal weapons detection, 15:37380 (R;US)
Murray, J.E., *See* Campbell, J.H., 15:37413
Murray, R.K., *See* Gehrke, R.J., 15:37879
Muzio, L.J., Simultaneous NO_x/SO_2 removal by the dry injection of lime-urea hydrate: Final report, 15:36897 (R;US)
Myatt, L., *See* Thome, R.J., 15:38096
Myers, D., *See* Riordan, C., 15:36827
Myers, D.R., *See* Vawter, G.A., 15:37418
Myers, E.G., *See* Trcka, D.E., 15:37853
Myklebust, R.L., *See* Romig, A.D. Jr., 15:37953
Myrick, M.L., High-energy metal to ligand charge-transfer states in ruthenium-diimine complexes, 15:37214 (J;US)
See Angel, S.M., 15:37298
Mystakides, E., First year evaluation of the NEES cooperative interruptible service program, 15:37065 (RA;US)

N

Nadel, S., Electricity savings from a small C and I lighting retrofit program: Approaches and results, 15:37063 (RA;US)
Naganuma, M., *See* Shimada, M., 15:38188
Nagashima, Keisuke, Electron temperature profile measurement using the filter absorption method in JT-60, 15:38029 (R;JP)
Nagashima, T., *See* Loring, M., 15:38252
Nagy, P.B., Slow wave propagation in air-filled porous materials and natural rocks, 15:37963 (J;US)
Naiman, M., *See* Calame, J., 15:38069
Najmabadi, F., *See* Wong, C.P.C., 15:38154
Nakagawa, T., *See* Kobayashi, Y., 15:37778, 15:37828
Nakai, T., *See* Purgalis, P., 15:38238
Nakajima, H., *See* Okuno, K., 15:38104
Nakamura, M., *See* Tajima, H., 15:37525
Nakamura, T., *See* Osborne, M.F., 15:36944
Nakanishi, Tsutomu, Consideration on feasibilities of double polarization experiments with polarized electron (or photon) beam and polarized target, 15:37486 (RA;JP)
See Takeda, Yasutoshi, 15:37487
Namkoong, G., *See* Loehle, C., 15:37610
Nann, H., *See* Seth, K.K., 15:37860
Nanstad, R.K., Influence of thermal conditioning media on Charpy specimen test temperature, 15:37393 (R;US)
Napoli, D., *See* Kim, H.J., 15:37869
Narayan, J., *See* Christen, D.K., 15:37228
See Kumar, A., 15:37256
See Singh, R.K., 15:37251, 15:37971
Nardi, V., *See* Bortolotti, A., 15:38299
Naruse, Y., *See* Anderson, J., 15:38105
See Bartlit, J.R., 15:38102
See Walthers, C., 15:38135
See Willms, R.S., 15:38101
Naruse, Yuji, Operation of the tritium process laboratory (TPL) in the Japan Atomic Energy Research Institute, 15:38106 (RA;US)
Naser, J., *See* Di Domenico, P., 15:36969
Nasstrom, J.S., *See* Foster, K.T., 15:37588
Nath, S., *See* Glass, G., 15:37786
Naus, D.J., Wide-plate crack-arrest tests utilizing prototypical and degraded (simulated) pressure vessel steels, 15:36995 (BA;US)
Naus, H.W.L., Off-shell form factors and low energy theorems for pion photoproduction, 15:37919 (J;US)
Nave, S.E., *See* Chang, C.P., 15:37325
Neal, M.J., *See* Ginley, D.S., 15:37261
Neau, E.L., *See* Harjes, H.C., 15:37411
Nedelec, J.C., Applied mathematics, 15:37990 (R;FR;In French)
Negus-de Wys, J., The geopressured-geothermal resource: Transition to commercialization, 15:36866 (R;US)
Neill, A.P., *See* Allen, E.J., 15:36982
Neill, D., *See* Holst, B., 15:36883
Nellis, W.J., *See* Weir, S.T., 15:37255
Nelson, B.E., *See* Hammonds, C.J., 15:38237
Nelson, B.P., *See* Mahan, A.H., 15:37306
Nelson, D.A., *See* Harrison, F.L., 15:37682
Nelson, D.E., *See* Felton, J.S., 15:37653
Nesbet, R.K., *See* Butler, W.H., 15:37987
Nettel, S.J., Filled-band model leading to supercurrents in La-Ba-Cu-O, 15:37269 (J;US)
Neumeyer, C., Preliminary power supply design for the TF coil system of CIT, 15:38189 (RA;US)
Newbury, D.E., *See* Romig, A.D. Jr., 15:37953
Newby, R., *See* Robertson, A., 15:36888
Newman, B.D., *See* Ebinger, M.H., 15:36795
Newman, W., *See* Hatcher, R.E., 15:38191
Newton, A.A., Advanced wall reversed field pinch, 15:38157 (RA;US)
Newton, J.O., *See* Lestone, J.P., 15:37884
Nexsen, W.E., Poisoning studies of an osmium-coated dispenser cathode, 15:37504 (J;US)
Neyatani, Y., *See* Horie, T., 15:38228
See Horiike, H., 15:38164
Ng, V., On the implementation of complex many-to-many relations in focus, 15:38321 (R;US)
Nguyen Trong Anh, Reaction mechanisms, 15:37344 (R;FR;In French)
Nguyen, C., *See* Cheng, S.C., 15:36913
Nguyen, D.C., *See* Tallerico, P.J., 15:37473
Nichols, B.D., *See* Gregory, W.S., 15:36802
Nicolls, N.G., Deformation effects in the compound nucleus decay using the spin-alignment method, 15:37871 (J;US)
See Sarantites, D.G., 15:37865
Nielsen, D.E., *See* Friedman, A., 15:38067
Nielsen, I., TEM investigations of the neutron irradiation behaviour of boron carbides, 15:37234 (R;DE;In German)
Niemer, K.A., Experimental and theoretical modeling of runaway electron damage for the design of tokamak plasma facing components, 15:38292 (BA;US)
Modeling of runaway electron damage for the design of tokamak plasma facing components, 15:38148 (RA;US)
Nieto, M.M., Important experiments to test for longer-ranged new gravitational forces, 15:37992 (R;US)
Nifenecker, H., *See* , 15:37894
See Lleres, A., 15:37894
Nikbakht, A., *See* Houlberg, L.M., 15:37013, 15:37014, 15:37015
Nilsen, E.T., *See* Sharifi, M.R., 15:37611
Nilson, D., *See* Casper, T., 15:38276
Nilson, D.G., *See* Oda, T., 15:38052
Nilsson, L., *See* Hakansson, A., 15:37859
Ninomiya, H., *See* Horie, T., 15:38228
See Horiike, H., 15:38164
Nishi, M., *See* Okuno, K., 15:38104

Nishi, M.F., Development of the proto-type conductors and design of the test coil for the fusion experimental reactor, 15:38098 (RA;US)
Nishi, N., *See* Misaizu, F., 15:37357
Nishikawa, T., *See* Horikoshi, G., 15:37437
Nishina, T., *See* Selman, J.R., 15:37044
Nishitani, Takeo, *See* Nagashima, Keisuke, 15:38029
Nishiyama, K., Physics study with muons, 15:37717 (RA;JP;In Japanese)
Nitschke, J.M., Null result for the weight change of a spinning gyroscope, 15:37780 (J;US)
Nitzan, A., *See* Ratner, M.A., 15:37299
Niwa, K., *See* Tajima, H., 15:37525
Nobel, P.S., *See* Chetti, M.B., 15:37673
Noer, R., *See* Padamsee, H., 15:37470
Noid, D.W., [Theoretical techniques for dynamics studies of polymers]: Foreign trip report, July 30–August 22, 1988, 15:37289 (R;US)
See Mueller, J., 15:37943
Nojiri, Shin-ichi, *See* Kobayashi, Makoto, 15:37806
Noll, P., *See* Tanga, A., 15:38012
Noma, Takashi, *See* Yamamoto, Yasushi, 15:38162
Nomura, Masaharu, Performance of BL10B and a simple performance test for EXAFS stations, 15:37488 (R;JP)
Norem, J., A high resolution beam profile monitor using Bremsstrahlung, 15:37472 (RA;US)
Noro, Tetsuo, Study of the NN interaction through (p, 2p) reactions and construction of focal plane detectors for a spectrograph pair, 15:37907 (RA;JP;In Japanese)
Northcliffe, L.C., *See* Glass, G., 15:37786
Norton, D., *See* Christen, D.K., 15:37228
Norton, D.P., Y-Ba-Cu-O thin films grown on rigid and flexible polycrystalline yttria-stabilized zirconia by pulsed laser ablation, 15:37249 (J;US)
Notin, C., Study and development of a mounted complier for wind turbines, 15:36876 (R;FR;In French)
Notis, M.R., *See* Bateman, C.A., 15:37257
Novotny, M.A., *See* Aukrust, T., 15:37265
Nowak, A., *See* Kupschus, P., 15:38203
Noyes, H.P., A finite, rational model for the EPR-Bohm experiment, 15:37812 (R;US)
Nyalesh, A.R., *See* Chehab, R., 15:37710

O

O'Brien, J.C., *See* Radousky, H.B., 15:37275
O'Brien, M.H., Combustion testing and thermal modeling of proposed CIT [Compact Ignition Tokamak] graphite tile materials, 15:38257 (R;US)
See Merrill, B.J., 15:38248
O'Brien, T.K., *See* Telschow, K.L., 15:37233
O'Connor, T., *See* Lawson, J.E., 15:38246
O'Hara, F.M. Jr., *See* Farrell, M.P., 15:37563
O'Malley, M.W., *See* Zutavern, F.J., 15:37410
Oakes, M.E., *See* Eways, S.E., 15:38009
Obenshain, F.E., *See* Plasil, F., 15:37881
Obert, W., *See* Massmann, P., 15:38180
Obot, N.T., Theoretical studies on the role of transition in determining friction and heat transfer in smooth and rough passages: Final report, 15:37374 (R;US)
Ocko, B.M., Smectic-layer growth at solid interfaces, 15:37314 (J;US)
See Schwartz, D.K., 15:37748
Oda, T., Start-effect measurement of high FEL [free-electron laser] electric fields in MTX [Microwave Tokamak Experiment] by laser-aided particle-probe spectroscopy, 15:38052 (R;US)
See Mizuno, K., 15:38079
Oda, Y., *See* Onozuka, M., 15:38200
Odajima, K., *See* Oda, T., 15:38052
Odekirk, J.R., *See* Smit, F.J., 15:36689
Odinek, J., *See* Martin, J.E., 15:37318
Oed, A., *See* Boucheneb, N., 15:37892
Ogata, H., *See* Tanaka, M., 15:37498
Ogawa, Hidemi, Channeling at higher energy, 15:37951 (RA;JP;In Japanese)
Ogawa, Y., *See* Loring, M., 15:38252
See Moriyama, S., 15:38236
Oh, Jai-Ho, *See* Schlesinger, M.E., 15:37566
Oh, M.S., Ammonia evolution from western and eastern oil shales, 15:36757 (J;US)
Ohasa, K., *See* Oda, T., 15:38052
Ohl, K.E., Improved experimental limit on $K_L \rightarrow \pi^0 e^+ e^-$, 15:37785 (J;US)
Ohlenschlaeger, L., Preclinical diagnosis and emergency medical care in case of radiation accidents, 15:36972 (R;DE;In German)
Ohmann, J.L., *See* Little, S.N., 15:37607
Ohnishi, M., *See* Yoshikawa, K., 15:38224
Ohriner, E.K., *See* Cooper, R.H., 15:37043
Ohsawa, Yukiharu, Electron motion in a nonlinear magnetosonic wave propagating perpendicularly to a magnetic field, 15:38037 (R;JP)
Ohshima, T., *See* Tanaka, M., 15:37498
Ohta, M., *See* Loring, M., 15:38252
See Moriyama, S., 15:38236
Ohtsubo, H., Electrodisintegration of deuteron at threshold, 15:37842 (RA;JP)
Oka, Y., *See* Kaneko, O., 15:38240
Oki, Takashi, *See* Hidaka, Yoshiaki, 15:36823
Okos, M.R., *See* Dale, M.C., 15:36821, 15:37144
Okuno, K., Experiments of the 1-m-bore, 30-kA superconducting demo poloidal coils, 15:38104 (RA;US)
See Anderson, J., 15:38105
See Bartlit, J.R., 15:38102
See Koizumi, K., 15:38178
See Nishi, M.F., 15:38098
See Walthers, C., 15:38135
See Willms, R.S., 15:38101
Oldaker, M., *See* Lawson, J.E., 15:38246
Oliveira, L.F., Hazard rate for a two-channel protective system subject to a high demand rate, 15:37385 (BA;US)
Oliver, B.F., Crystal growth and deformation behavior of TiAl aluminides, 15:37193 (R;US)
Oliver, W.C., *See* Cornett, K.D., 15:37226
See Fabes, B.D., 15:37225
See Oliver, B.F., 15:37193
See Sparks, C.J., 15:37180
Olivera, J.J., Failure of Inconel X-750 bolts of internals of the CHOOZ-A nuclear power plant, 15:36910 (R;FR)
Olivier, H., Synthesis of organolanthanides by metal addition on insaturated substrates in ether and reactivity, 15:37348 (R;FR;In French)
Ollivier, G., *See* Buende, R., 15:38108
Olmstead, M., *See* Thome, R.J., 15:38096
Olson, C.L., *See* Prestwich, K.R., 15:38262
Olson, R.E., *See* Reinhold, C.O., 15:37729
Olsson, N., *See* Hakansson, A., 15:37859
Oma, K.H., *See* Farnsworth, R.K., 15:36786, 15:36787
Onozuka, M., Development of upgraded pellet injector for JT-60, 15:38200 (RA;US)
Oona, H., *See* Lindemuth, I.R., 15:38307
Ordonez, C., *See* Montalvo, E., 15:38011
Ordonez, C.A., Impurity release disruption effects, and thermomechanical stress analysis of the first wall system for the IGNITEX experiment, 15:38130 (RA;US)
Orihara, Hikonojo, Nuclear physics through charge-exchange reactions, 15:37847 (RA;JP;In Japanese)
Orji, C.U., A methodology for benchmarking distributed database management systems, 15:38341 (R;US)
Orr, N.A., *See* Catford, W.N., 15:37850
Orsini, A., *See* Andreani, R., 15:38160
Orszag, A., Applied optics, 15:37186 (R;FR;In French)
Ortale, C., *See* Bao, X.J., 15:37248
Osborne, M.F., Data summary report for fission product release test VI-3, 15:36944 (R;US)
[Thermal reactor safety]: Foreign trip report, October 2–13, 1988, 15:36986 (R;US)
Osborne, Z.A., Short-range structure of fluorine-modified phosphate glass, 15:37292 (R;US)
Ossandon, J.G., *See* Thompson, J.R., 15:37976

Otake, Yoshie, Neutron interference experiment and quantum-mechanical observation problem, 15:37924 (RA;JP;In Japanese)
Othman, Ibrahim, Radiation protection glossary, 15:37936 (R;SY;In Arabic)
Ott, K.C., *See* Cooke, D.W., 15:37259
Otto, R., *See* Hoenig, C., 15:37243
Otts, J.V., *See* Ghanbari, C.M., 15:36849
Ouesiati, M., *See* Fusco, F.A., 15:37303
Outka, D.A., *See* Kubiak, G.D., 15:37960
Overton, W.C. Jr., Experiments on superconductor imaging surface magnetometry, 15:37406 (R;US)
See van Hulsteyn, D.B., 15:37978
Ovrut, B.A., *See* Evans, M., 15:37819
Owens, D.K., *See* Barnes, G.W., 15:38147
See Schmidt, G.L., 15:38255
Oxendine, L.B., Integrated regional resources management: Based on the experience of the Tennessee Valley Authority, 15:37018 (R;US)
Ozog, M., New Jersey conservation analysis project: Energy savings from residential programs, 15:37069 (RA;US)
See Violette, D., 15:37082

P

Pacheco, J., Engineering-scale experiments of solar photocatalytic oxidation of trichloroethylene, 15:36856 (R;US)
Padamsee, H., Does UHV annealing above 1100C as a final surface treatment reduce field emission loading in superconducting cavities, 15:37470 (RA;US)
Prospects for RF application of high TC superconductors, 15:37467 (RA;US)
Padilla, A. Jr., Analysis of Beyond Design Basis Events for the Fast Flux Test Facility UO_2 core, 15:36989 (R;US)
Fuel aspects of Beyond Design Basis Event analyses for the Fast Flux Test Facility, 15:36928 (R;US)
Padmanaban, N., Thermoelectric power measurements of $CuCr_{2-x}Al_xO_4$ and $Cu_{1-x}Mg_xCr_2O_4$ solid solution spinel oxides, 15:37169 (J;US)
Pagani, C., *See* Ferrucci, L., 15:37480
Pahl, R.G., Steady-state irradiation testing of U-Pu-Zr fuel to >18% burnup, 15:36924 (R;US)
Paik, Chan Y., MAAP [Modular Accident Analysis Program] steam generator modeling and benchmarking with Westinghouse MB-2 tests, 15:36968 (R;US)
Pain, M., The 15 MW microwave generator and launcher of the lower hybrid current drive experiment on JET, 15:38167 (RA;US)
Painter, P.C., A lattice model describing hydrogen bonding in polymer mixtures, 15:37320 (J;US)
Pal, B.C., [Packaging regulations for chemical explosives]: Foreign trip report, January 26, 1988–February 1, 1988, 15:37552 (R;US)
Palacin, S., Molecular engineering: Highly ordered langmuir-blodgett films based on a cobalt phthalocyanine and its axial complexation, 15:37217 (J;US)
Palma, T., *See* Boschi, A., 15:38169
Palmer, R.B., *See* Hopkins, D.B., 15:37483
Palmrose, D.E., Nuclear radiation analysis of the IGNITEX experiment, 15:38295 (BA;US)
Pan, A., *See* Rocco, R.E., 15:38125
Pan, L.S., *See* Kania, D.R., 15:37308
Pancella, P.V., *See* Goodwin, J.E., 15:37463
Papastergiou, S., *See* Altmann, H., 15:38131
See Bickley, A.J., 15:38253
Parish, T.A., *See* Miller, G.A., 15:38215
See Palmrose, D.E., 15:38295
Park, H., *See* Stratton, B.C., 15:38036
See Synakowski, E.J., 15:38034
Park, Hyeon K., Error analysis of a new asymmetric Abel-inversion method, 15:38032 (R;US)
Park, J.Y., *See* Kassner, T.F., 15:36906
Parke, S., The structure of gluon radiation in QCD, 15:37813 (J;US)
Parker, F.R., *See* Bohl, W.R., 15:36926
Parker, T.E., Soot formation in fuel sprays, 15:36742 (BA;US)
Parks, P.B., *See* Vahala, L.L., 15:38017
Parma, A., *See* Baker, W.R., 15:38139
Parmentier, N., *See* L'Homme, A., 15:36952
Pate, S.F., *See* Wuosmaa, A.H., 15:37864
Patnaik, P.C., Coatings for high temperature corrosion in aero and industrial gas turbines, 15:36890 (BA;US)
Patterson, D.R., *See* Liu, Y.Y., 15:36961
Patterson, G.A., *See* Chan, K.T., 15:37311
Patterson, P.E., *See* Rinehart, L.F., 15:37408
Pattinson, T.R., *See* Hoffer, J.K., 15:38260
Paul, S.F., Neutral beam emission spectroscopy diagnostic for measurement of density fluctuations on the TFTR tokamak, 15:38033 (R;US)
Paulin, S.E., Observation of a phase transition in the sedimentation velocity of hard spheres, 15:37964 (J;US)
Pavlov, B.S., *See* Kuperin, Yu.A., 15:37993
Pavlovsky, D.A., Texas experimental tokamak electron cyclotron resonant heating system, 15:38235 (RA;US)
See Terry, D.R., 15:38242
Payne, D.A., *See* Schwartz, R.W., 15:37240
Payne, S.A., *See* Powell, R.C., 15:37324
Peacock, R., *See* Newton, A.A., 15:38157
Pease, R.F., *See* Marella, P.F., 15:37957
Pedersen, D.R., *See* Tzanos, C.P., 15:36922
Pedersen, E.L., *See* Markee, N.L., 15:37109
Pedroni, R.S., Analyzing power measurements for elastic scattering of 17 MeV neutrons from ^{120}Sn, 15:37872 (J;US)
Pelloux, R.M., *See* Vieira, R., 15:38095
Peng, Y.K., *See* Smith, R.T.C., 15:38117
Peng, Y.K.M., MHD equilibrium and stability considerations for high-aspect-ratio ARIES-I tokamak reactors, 15:38014 (RA;US)
See Bartlit, J.R., 15:38151
See Sze, D.K., 15:38153
Penner, J.E., Cloud albedo, greenhouse effects, atmospheric chemistry, and climate change, 15:37590 (J;US)
Pennycook, S.J., High-resolution Z-contrast imaging in the stem, 15:37941 (R;US)
Incoherent imaging of materials structure and composition by Z-contrast stem, 15:37281 (R;US)
Peppas, N.A., Macromolecular coal structure as revealed by novel diffusion tests: Quarterly technical report, January 15, 1990–April 15, 1990, 15:36703 (R;US)
Percy, F.G., *See* Hembree, D.M., 15:38007
Perez, R.B., *See* Corcuera, R.P., 15:36941
See Difilippo, F.C., 15:37539
Perks, M., *See* Cahalan, J., 15:36955
Perry, E., *See* Gettelfinger, G., 15:38185
Perry, F.C., Development of a laser diagnostic system at PBFA II for light-ion-beam research, 15:38088 (BA;US)
Perry, M.D., *See* Kania, D.R., 15:37308
Pershan, P.S., *See* Schwartz, D.K., 15:37748
Pescatore, C., Zircaloy cladding performance under spent fuel disposal conditions: Progress report, May 1–October 31, 1989, 15:36766 (R;US)
Peters, H.P., *See* Hennen, L., 15:37025
Peters, J., *See* Evans, P., 15:37064
Peters, J.S., Comparative analysis of three commercial sector financing mechanisms, 15:37055 (RA;US)
Peters, S.W., *See* Julien, J.T., 15:36978
Petersen, F., Comprehensive evaluation: A commercial sector example, 15:37086 (RA;US)
Petersen, P.I., *See* Kim, Jinchoon, 15:38118
Peterson, E.J., *See* Cooke, D.W., 15:37259
Peterson, R.J., *See* Clausen, B.L., 15:37854
Peterson, R.R., *See* Sviatoslavsky, I.N., 15:38234
Peyrovi, M.H., Study of the destruction of coke and of its precursors in presence of hydrogen on platinum base catalysts, 15:36728 (R;FR;In French)
Peyton, B., *See* Sanford, T.W.L., 15:37445
Pezzimenti, D.M., The use of the Deep Kerfer for thick, steel-reinforced concrete cutting, 15:36775 (R;US)
Pfirsch, D., Generalized Cherry oscillators and negative energy waves, 15:38027 (R;DE)
Pfister, U., *See* Euringer, H., 15:38143

Phelps, D.A., The coaxial cavity locked HPM tube and external HPM feedback stabilization, 15:38290 (BA;US)
Phelps, M.E., *See* Daghighian, F., 15:37654
Phelps, R.D., *See* Anderson, P.M., 15:38227
Phelps, T.J., Microbial biomass and activities associated with subsurface environments contaminated with chlorinated hydrocarbons, 15:37626 (J;US)
Phillips, J., *See* Hong, R., 15:38142
Phillips, J.A., *See* Weber, P.G., 15:38063
Phillips, N.E., *See* Amato, A., 15:37288, 15:37979, 15:37980
Philpot, S.R., Anomalous elastic behavior in superlattices of twist grain boundaries in silicon, 15:37321 (J;US)
Phips, B.F., *See* Henderson, S.D., 15:37825
Pianetta, P., *See* Kania, D.R., 15:37308
Pickrell, M.M., *See* Weber, P.G., 15:38063
Pien, C., *See* Rocco, R.E., 15:38125
Pienkowsky, L., *See* Lleres, A., 15:37894
Piepel, G.F., *See* Shade, J.W., 15:36785
Pierrey, J.L., *See* Olivera, J.J., 15:36910
Pigg, S., *See* Schlegel, J., 15:37093
Pillonen, L.E., *See* Mischke, R.E., 15:37526
Pillsbury, R.D. Jr., Poloidal field coil system optimization for the Compact Ignition Tokamak (CIT), 15:38099 (RA;US)
See Thome, R.J., 15:38096
See Winn, P., 15:38097
Pin, F.G., *See* Harber, K.S., 15:38331
Pindzola, M.S., Electron-impact ionization data for the nickel isonuclear sequence, 15:37715 (R;US)
Pines, D., *See* Monien, H., 15:37274
Piovan, R., *See* Gaio, E., 15:38231
Pitts, J.H., *See* Wolfe, C.R., 15:37304
Pizzichini, G., *See* Boer, M., 15:37692
Pizzuto, A., *See* Cecchini, A., 15:38124
Planchon, H.P., *See* Vilim, R.B., 15:36937
Plasil, F., Nucleus-nucleus collisions at 60 to 200 GeV/nucleon: Results from the WA80 experiment at CERN, 15:37881 (R;US)
Plimpton, S.J., Molecular dynamics simulations of grain-boundary diffusion for varying tilt angle geometries, 15:37196 (R;US)
See Romig, A.D. Jr., 15:37953
Plum, M.A., *See* Clausen, B.L., 15:37854
Pohl, B.A., *See* Blann, M., 15:37909
See Scobel, W., 15:37863
Pollock, R.E., *See* Goodwin, J.E., 15:37463
Pomphrey, N., *See* Strickler, D.J., 15:38123
Ponden, R., *See* Duchane, D.V., 15:36870
Pope, R.B., [Regulations for the safe transport of radioactive material]: Foreign trip report, September 27–30, 1988, 15:36761 (R;US)
Popescu, D.G., *See* Dracoulis, G.D., 15:37873
Porter, J.L., *See* Hsing, W.W., 15:38075
Porter, L.E., Methods of calculating the Barkas-effect correction to Bethe–Bloch stopping power, 15:37935 (J;US)
Porter, W.D., *See* Sparks, C.J., 15:37180
Post, B., X-ray crystal devices for measuring compression and stability of laser fusion targets: Final report, 15:38020 (R;US)
Post, R.F., The mirrortron ion accelerator concept, 15:38064 (BA;US)
Post, R.G., Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education: Volume 1, Overview and general waste management: Proceedings, 15:36772 (R;US)
Poteri, A., Probabilistic system assessment code SYVAC/FI for safety analysis of nuclear waste disposal, 15:36792 (R;FI;In Finnish)
Potier, J.P., *See* Delahaye, J.P., 15:37448
Potter, J.E., *See* Bieg, K.W., 15:38261
Poukey, J.W., *See* Mazarakis, M.G., 15:37482
See Sanford, T.W.L., 15:37445
See Wilson, J.M., 15:37446
Powell, C., *See* Bortolotti, A., 15:38299
Powell, H.T., Laser research and development, 15:38268 (RA;US)
See Wolfe, C.R., 15:37304
Powell, R.C., Four-wave mixing of Nd^{3+}-doped crystals and glasses, 15:37324 (J;US)
Prager, S.C., *See* Lovell, T.W., 15:38284
Prahl, R., *See* Kreitler, V.L., 15:37096
Prairie, M., *See* Pacheco, J., 15:36856
Pratt, A.P., *See* Hayward, R.J., 15:38115
Preece, D.S., Spherical element bulking mechanisms for modeling blasting induced rock motion, 15:36754 (R;US)
Pregenzer, A.L., *See* Woodworth, J.R., 15:38283
Premuzic, E.T., Prospects for thermophilic microorganisms in microbial enhanced oil recovery (MEOR), 15:36723 (R;US)
Presser, N., *See* Robie, D.C., 15:37363
Prestwich, K.R., Design of a light-ion-beam driver for the Laboratory Microfusion Facility, 15:38262 (R;US)
Prevost, J.H., *See* Lee, P.C.Y., 15:37970
Price, D., High current RF accelerator for FEL applications, 15:37556 (RA;US)
Prill, R.J., *See* Turk, B.H., 15:37591
Prince, P.P., *See* Ballard, E.O., 15:38111
Probert, P., *See* Brouchous, D., 15:38087
Proctor, I.D., *See* Felton, J.S., 15:37653
Prohaska, G., *See* Gilli, R., 15:36976
Protopopescu, V., Recent advances in analytic combat simulation: From modeling to validation and beyond, 15:37545 (R;US)
[Discrete kinetic theory, lattice gas dynamics and foundations of hydrodynamics]: Foreign trip report, September 17–October 2, 1988, 15:37741 (R;US)
Prowler, D., Building envelopes, 15:36851 (BA;US)
Pruessmann, H., *See* Burkhardt, H., 15:36719
Pujols, H.C., Hypervelocity explosive launchers, 15:37549 (R;US)
Purgalis, P., Design of the ITER (International Thermonuclear Experimental Reactor) neutral beam system beamline, United States concept, 15:38238 (RA;US)
See Grisham, L.R., 15:38149
Pusateri, J.A., The CIT toroidal field coil and structure design and assembly approach, 15:38217 (RA;US)
Pushis, D.O., *See* Liu, Y.Y., 15:36961
Pyle, R.V., *See* Wada, M., 15:37211

Q

Qadri, S.B., *See* Cammarata, R.C., 15:37205
Qi, N., *See* Adler, L.K., 15:38085
Qualls, A.L., Eight-shot pneumatic pellet injector for the Advanced Toroidal Facility, 15:38208 (RA;US)
Quevedo, F., *See* Burgess, C.P., 15:37816
Quick, C.R., Excitation of atoms passing through a TEM_{00} Gaussian laser beam at relativistic velocities, 15:37415 (J;US)
Quintana, M.A., *See* Richards, E.H., 15:36837
Quintana, P., Compound formation and phase equilibria in the system Li_4SiO_4-$LiGaSiO_4$, 15:37170 (J;US)

R

Rabas, T.J., *See* Obot, N.T., 15:37374
Rader, M., *See* Alexeff, I., 15:38065
Radousky, H.B., Metallization and superconducting properties of $YBa_2Cu_3O_{6.2}Br_y$, 15:37275 (J;US)
See Bonner, B.P., 15:37278
See McCarty, K.F., 15:37266
Raffray, A.R., *See* Federici, G., 15:38121
Raftopoulos, S., *See* LaMarche, P.H., 15:38136
Ragland, W.A., EBR-II in-vessel natural circulation experiments on hot and cold pool stratification, 15:36963 (R;US)
See Hill, D.J., 15:36956
Rainer, F., *See* Wolfe, C.R., 15:37244, 15:38272
Rajeev, S.G., *See* Hong, D.K., 15:37815
Rakowsky, G., *See* Barletta, W.A., 15:37447
Ramberg, E.J., *See* Anderson, D.F., 15:37519
Ramesh, R., Lorentz electron microscopy of iron-rare-earth-boron sintered permanent magnets, 15:37212 (J;US)
See Koestler, C., 15:37209
Ramey, D.B., *See* Barker, L.E., 15:38317
Ramirez, J.J., *See* Prestwich, K.R., 15:38262
See Sanford, T.W.L., 15:37445
Ramirez, L., *See* Sanz, J.L., 15:37638

Rankin, P., Radiative corrections at SLC and LEP, 15:37797 (J;US)
Rao, I.M., Leaf magnesium alters photosynthetic response of low water potentials in sunflower, 15:37642 (J;US)
Rapaport, J., *See* Glover, C.W., 15:37855
Raridon, R.J., *See* Becraft, W.R., 15:37432
Rashid, Y.R., *See* Billone, M.C., 15:36997
Rasines, I., *See* Salvador, P., 15:37168
Rasmuson, D.M., *See* Russell, K.D., 15:36980
Rasmussen, D.A., The role of stellarators in understanding toroidal transport physics, 15:38062 (BA;US)
Rasnake, D.G., EPA [Environmental Protection Agency] performance tests for particulate and SO_2 conducted at the DOE Coal-Fired Flow Facility, 15:37041 (R;US)
Rathbun, P.R., *See* Van Liere, K.D., 15:37106
Rathi, A., *See* Greene, D.L., 15:37159
Rathi, Anju, *See* Janson, B.N., 15:37140
Rathke, G., *See* Sanders, S.J., 15:37862
Ratner, M.A., Polymeric electrolytes and polyelectrolytes: Salt concentration and domain, 15:37299 (BA;US)
Rauenzahn, R.M., *See* Besnard, D.C., 15:37739
Raulins, W.T., *See* Parker, T.E., 15:36742
Rawlinson, K.S., *See* Andraka, C.E., 15:36847
Rawool, M.W., *See* Glass, G., 15:37786
Ray, L.P., Monocular 3D vision for a robot assembly environment, 15:37381 (R;US)
Razdan, M.K., Modeling and measurements in coal-water slurry combustion for direct-fired gas turbine applications, 15:36714 (BA;US)
Read, M.E., *See* Lawson, W., 15:37481
Reaves, K., Adsorption of spent fuel storage pool contaminants into metal surfaces, 15:37383 (R;US)
Rebhan, A., *See* Bender, C.M., 15:37822
Reda, D.C., Liquid crystals for surface shear stress visualization on wind turbine airfoils, 15:36881 (BA;US)
Reddan, W.G., Compact Ignition Tokamak, vacuum vessel, design and development, 15:38141 (RA;US)
Redi, M.H., Influence of MHD effects and edge conditions on ITER helium ash accumulation and sustained ignition, 15:38035 (R;US)
Redmond, E.L. II, *See* Ryskamp, J.M., 15:36950
Redwine, R.P., *See* Burger, W.J., 15:37866
Reed, K.J., *See* Chen, M.H., 15:37725
Reed, K.W., *See* Harjes, H.C., 15:37411
Reed, R.W., *See* David, S.A., 15:36691
Reeve, J.N., Structure and regulation of methanogen genes: Progress report, July 1, 1987–June 30, 1989, 15:37630 (R;US)
Reggiori, A., *See* Martinis, L., 15:38198
Reginato, L.L., *See* Hopkins, D.B., 15:37483
Regis, J.P., *See* Rhodes, E.A., 15:36954
Rehels, N., *See* Staffler, R., 15:38134
Rehmat, A., *See* Robertson, A., 15:36888
Reichlin, R., *See* Bonner, B.P., 15:37278
Reid, R.L., *See* Bartlit, J.R., 15:38151
Reiersen, W.T., Physics optimization of the Compact Ignition Tokamak (CIT), 15:38194 (RA;US)
Reilly, S., Infrared radiation of SF_6 and its application to gas-filled double-pane windows, 15:37389 (J;US)
Reimus, M.A.H., *See* Farnsworth, R.K., 15:36786
Reinhold, C.O., Excitation of atomic hydrogen by fully stripped ions, 15:37729 (J;US)
Reinovsky, R.E., *See* Lindemuth, I.R., 15:38307
Reis, E., *See* Baxi, C.B., 15:38133
See Gallix, R., 15:38128
See Smith, J.P., 15:38211
Reiser, M., *See* Lawson, W., 15:37481
Reister, D.B., Oil production in the United States, 15:36733 (BA;US)
Remington, B.A., *See* Blann, M., 15:37909
See Scobel, W., 15:37863
Remsen, D., *See* Loring, M., 15:38252
Ren, C., Tensor coupling of the ρ meson in a chiral confining model, 15:37803 (J;US)
Repetti, T.E., *See* Gilgenbach, R.M., 15:38072
See Miller, J.D., 15:38281
Resnick, J., The design of a 400 kV parallel plate electrostatic analyzer for use with the 2 MeV heavy ion beam probe, 15:38082 (BA;US)
Ress, D., Design of thick aperture for fine-resolution neutron penumbral imaging, 15:38271 (R;US)
Reynolds, C., *See* Kempton, W., 15:37070
Reynolds, C.L., *See* Ebinger, M.H., 15:36795
Rhoades, W.A., [International conference on radiation shielding]: Foreign trip report, September 11–16, 1988, 15:37931 (R;US)
Rhodes, B.A., Improved method for the direct labeling of antibodies with Tc-99m, 15:37647 (R;US)
One step Tc-99m labeling of antibodies for use in inflammation imaging, 15:37646 (R;US)
Rhodes, E.A., Transient feedback from fuel motion in metal IFR [Integral Fast Reactor] fuel, 15:36954 (R;US)
Rhodes, W., *See* Ma, X., 15:38003
Rhodes, W.D., Frequency response testing at Experimental Breeder Reactor II using discrete-level periodic signals, 15:36923 (R;US)
Ricco, A.J., *See* Frye, G.G., 15:37238
Rice, B., *See* Casper, T., 15:38276
Rich, B.L., Internal dosimetry and control, 15:37667 (R;US)
Rich, D.C., Highly polymorphic locus D15S24 (CMW-1) maps to 15pter-q13. [HGM9 provisional no. D15S24], 15:37641 (J;US)
Richard, F., *See* Chehab, R., 15:37710
Richard, J.M., Neutron-Antineutron oscillations in nuclei, 15:37787 (R;FR)
Richard, P., *See* Lee, D.H., 15:37728
Richards, E.H., Performance testing and qualification of Sandia's third baseline photovoltaic concentrator module, 15:36837 (R;US)
Photovoltaic concentrator module technology, 15:36835 (R;US)
Reliability of photovoltaic concentrator modules, 15:36836 (R;US)
Richards, G.A., *See* Morris, G.J., 15:36715
Richardson, D., *See* Bayes, D.V., 15:38112
Rickard, W.H. Jr., *See* Brandt, C.A., 15:37601
Ridley, L., Site, community, and urban planning, 15:36850 (BA;US)
Rigadello, D., *See* Baker, W.R., 15:38139
Riggs, C.R., *See* Cooper, R.H., 15:37043
Rigsbee, J.M., *See* Chen, C.H., 15:37200
Riles, K., *See* Daoudi, M., 15:37801
Riley, M.E., Growth of parametric fields in (2+1)-photon laser ionization of atomic oxygen, 15:37730 (J;US)
Riley, R.L., *See* Baker, R.W., 15:37147, 15:37148
Rinckel, T., *See* Goodwin, J.E., 15:37463
Rinehart, L.F., A repetitive, one microsecond, thirty-five kilojoule, two hundred kilovolt pulse generator, 15:37408 (R;US)
Ringel, S.R., *See* Rohatgi, A., 15:37293
Ringelberg, D., *See* Phelps, T.J., 15:37626
Rino, J.P., *See* Vashishta, P., 15:37300
Rintamaa, R., *See* Wallin, K., 15:37199
Riordan, C., SERI Solar Radiation Resource Assessment Project: FY 1989 annual progress report, 15:36827 (R;US)
Riordan, C.J., The effects of urban air pollution on solar radiation, 15:36829 (R;US)
Riseborough, P.S., Fermi liquid character in the photoemission/inverse photoemission spectra of highly correlated electron systems, 15:37965 (J;US)
Riseman, T.M., *See* Sternlieb, B.J., 15:37268
Risman, M., *See* Schueler, V., 15:37107
Ristinen, R.A., *See* Clausen, B.L., 15:37854
Ristori, C., *See* Lleres, A., 15:37894
Riva, G., *See* Martinis, L., 15:38198
Rnee, M.J., *See* Weidman, D.J., 15:38070
Roach, D.P., Recertification of a high pressure vessel using nondestructive evaluation techniques, 15:36891 (BA;US)
Roberto, J.B., *See* Tsai, C.C., 15:37716
Roberts, D., *See* Brouchous, D., 15:38087
Roberts, D.E., *See* Carroll, D.F., 15:37253
Roberts, M.L., *See* Sale, K.E., 15:37856
Roberts, R.G., *See* Harriman, P.N., 15:37789
Robertson, A., Second-generation pressurized fluidized bed [PFB] combustion plant: Conceptual design and optimization of a second-generation PFB combustion plant, Phase 1, Task 1: Volume 1, 15:36888 (R;US)

Robie, D.C., The intramolecular kinetic isotope effect for the reaction $O(^3P)$+HD, 15:37363 (J;US)
Robinson, B.A., Modeling the hydraulic characteristics of the Fenton Hill, New Mexico Hot Dry Rock reservoir, 15:36860 (R;US)
Robinson, B.R., *See* Duchane, D.V., 15:36870
Robinson, L., Proposed neutron activation analysis facilities in the Advanced Neutron Source, 15:36945 (R;US)
Robinson, S.M., *See* Hall, R., 15:36774
Robinson, W.R., *See* Doemer, R.C., 15:36953
Robiscoe, R.T., *See* Kadish, A., 15:38086, 15:38094
Robson, D., *See* Trcka, D.E., 15:37853
Rocco, R.E., Radiation shielding for TFTR D-T operation, 15:38125 (RA;US)
Roccon, M., *See* Andreani, R., 15:38160
Rochau, G.E., Performance of magnetically injected plasma opening switches for the Particle Beam Fusion Accelerator 2 (PBFA 2), 15:38263 (R;US)
Rodean, H.C., Toward more realistic material models for release and dispersion of heavy gases, 15:37587 (R;US)
Rodin, G., *See* Ordonez, C.A., 15:38130
Rodriguez, A.E., Resolution requirements for modeling streamer formation in a spark gap, 15:38066 (BA;US)
Rodriguez, J.G., Field experience in using laser acoustic sensing for inspection, 15:37394 (R;US)
Roe, J.N., *See* Angel, S.M., 15:37298
Roesler, D., *See* Benfatto, I., 15:38221
Rogers, E.A., Evaluating the cost-effectiveness of a commercial and industrial conservation program, 15:37095 (RA;US)
Evaluation of a residential appliance rebate program using billing record analyses, 15:37085 (RA;US)
Rogers, G.O., Evaluating protective actions for chemical agent emergencies, 15:37560 (R;US)
Rogers, L.J., The United States Wind Energy Technology Research Program, 15:36879 (BA;US)
Rogers, R.D., *See* Wolfram, J.H., 15:36992
Rogers, R.S.C., *See* Boecker, W.D., 15:37237
Rohatgi, A., Research on design and fabrication of high-efficiency solar cells, 15:37293 (R;US)
Roldt, R.M., *See* Kim, H.J., 15:36711
Rojas-Gonzalez, L.F., *See* DiGioia, A.M. Jr., 15:36998
Romain, R., *See* Massmann, P., 15:38180
Romanelli, P., *See* Accetta, F.S., 15:37817
Romig, A.D. Jr., Application of parallel computing to the Monte Carlo simulation of electron scattering in solids: A rapid method for profile deconvolution, 15:37953 (R;US)
Ronsten, G., Pressure measurements on a 5.35 m hawt in CARDC wind tunnel compared to theoretical pressure distributions, 15:36878 (R;SE)
Roos, P.G., *See* Burger, W.J., 15:37866
Roquemore, A.L., Improvements in microchannel plate operating characteristics, 15:38074 (BA;US)
Rosenblum, M.D., *See* Kumar, A., 15:36842
Rosenbluth, M.L., *See* Kumar, A., 15:36842
Rosenbluth, M.N., *See* Dong, J.Q., 15:38008
See Montalvo, E., 15:38011, 15:38193
Ross, M.A., *See* Goodwin, J.E., 15:37463
Rossmanith, R., *See* Heifets, S.A., 15:37476
Rossmassler, R.L., *See* LaMarche, P.H., 15:38136
Rostoker, N., Ion betatron, 15:38288 (BA;US)
See Wessel, F.J., 15:38060
Roth, J.R., Ball lightning as a route to fusion energy, 15:38232 (RA;US)
See Jiang, L., 15:38077
Rothe, K.E., *See* Becraft, W.R., 15:37432
Rothschild, W., *See* Dugger, M.T., 15:37241
Roudeau, P., Selected topics on B physics at Lep, 15:37772 (R;FR)
Roussel-Dupre, R., *See* Graham, G., 15:38078
Roy, G.D., *See* Doss, E.D., 15:37155
Roy, N., *See* Becker, J.A., 15:37882
Royl, P., *See* Cahalan, J., 15:36955
Rozhansky, V., The effect of the radial electric field on the L-H mode transition in Tokamaks, 15:38047 (R;SE)
See Tendler, M., 15:38042
Ruaudel-Teixier, A., *See* Palacin, S., 15:37217
Rubin, D.L., *See* Padamsee, H., 15:37470
Rubin, M., *See* Reilly, S., 15:37389
Rubow, L., *See* Robertson, A., 15:36888
Ruckman, M.W., *See* Gao, Y., 15:37322
Rudberg, D.A., *See* Hart, A.T., 15:37039
Rufo, M.W., An investigation of commercial and industrial utility demand-side management program impacts, 15:37100 (RA;US)
Ruiz, C.L., *See* Woodworth, J.R., 15:38283
Rumbaugh, J.H., *See* Lissaman, P.B.S., 15:36884
Rundel, P.W., *See* Sharifi, M.R., 15:37611
Russell, K.D., Integrated Reliability and Risk Analysis System (IRRAS) Version 2.0 user's guide, 15:36980 (R;US)
Ruth, R.D., *See* Lavine, T.L., 15:37478
Ruther, W.E., *See* Kassner, T.F., 15:36906
Rutkowski, H.L., *See* Hewett, D.W., 15:37503
Ruzic, D.N., *See* Caughman, J.B.O. II, 15:38129
Ryan, P.M., *See* Becraft, W.R., 15:37432
See Caughman, J.B.O. II, 15:38129
Rymes, M., *See* Riordan, C., 15:36827
Ryskamp, J.M., Reactivity studies on the final preconceptual reference design of the Advanced Neutron Source, 15:36950 (R;US)

S

Sabroux, J.C., A geochemical study of the fluids in several wells: The Momotombo geothermal field, 15:36865 (R;FR;In French)
Saccardo, B., *See* , 15:38113
See Baker, W.R., 15:38113
Sadlon, K., *See* Crandall, R.S., 15:36839
Saeed, M., Optimization and characterization of a high repetition rate, high intensity Nd:YLF regenerative amplifier, 15:37417 (J;US)
See Kim, D., 15:37732
Saetherblom, H.E., *See* Drake, J.R., 15:38041
Saigusa, M., *See* Moriyama, S., 15:38236
Saini, S., *See* Plasil, F., 15:37881
See Wuosmaa, A.H., 15:37864
Sakai, K., *See* Kanada, H., 15:37896
Sakai, Kenji, *See* Kawai, Takeshi, 15:37928
Salat, A., On the roles of the density and temperature gradients in the theory of nonlinear drift waves, 15:38028 (R;DE)
Sale, K.E., Measurement of the half-life of ^{8}Li, 15:37856 (J;US)
Sale, M.J., *See* King, A.W., 15:37571
Salem, J.A., *See* Jenkins, M.G., 15:37229
Sales, B.C., *See* Thompson, J.R., 15:37976
Salk, M.S., *See* Houlberg, L.M., 15:37013, 15:37014, 15:37015
Salomons, E., Monte Carlo study of tracer and chemical diffusion of oxygen in $YBa_2Cu_3O_{6+2c}$, 15:37273 (J;US)
Salvador, P., XPS study of the dependence on stoichiometry and interaction with water of copper and oxygen valence states in the $YBa_2Cu_3O_{7-x}$ compound, 15:37168 (J;US)
Salzman, G.C., A CLIPS expert system for clinical flow cytometry data analysis, 15:37640 (R;US)
Samara, G.A., Temperature and frequency dependences of the dielectric properties of $YBa_2Cu_3O_{6+x}$ ($x \approx 0$), 15:37270 (J;US)
Sand, J.R., *See* Vineyard, E.A., 15:37130
Sanda, A.I., Physics of the B system, 15:37805 (RA;JP)
Sanders, J.M., *See* Lee, D.H., 15:37728
Sanders, S.J., Additional evidence for fusion-fission in $^{32}S+^{24}Mg$ reactions: Division of excitation energy and spin in the fission fragments, 15:37862 (J;US)
Sanford, T.W.L., Temporal characterization of the 19-MV, 700-kA HERMES III electron beam, 15:37445 (R;US)
Santamaria, G., *See* Hong, R., 15:38142
Santarius, J.F., Energy conversion options for ARIES-III - A conceptual D-^{3}He tokamak reactor, 15:38155 (RA;US)
See Emmert, G.A., 15:38163
Santavicca, D.A., *See* Ho, C.M., 15:36753
Santinelli, M., *See* Crisanti, F., 15:38127
Santini, D.J., *See* Harrison, W., 15:37625
Santoro, R.T., *See* Protopopescu, V., 15:37545
Sanz, J.L., Variable rRNA gene copies in extreme halobacteria, 15:37638 (J;US)

Sapoval, B., The condensed matter physics, 15:37188 (R;FR;In French)
Sapozhnikov, M.G., *See* Kharzeev, D.Eh., 15:37895
Sarachik, M.P., *See* Zhang, Y., 15:37316
Sarantites, D.G., Nuclear-structure effects in proton evaporation spectra, 15:37865 (J;US)
See Nicolis, N.G., 15:37871
Sarff, J.S., *See* Beckstead, J.A., 15:38285
Sarkar, S., *See* Levy, C.D.P., 15:37500
Sarto, S., *See* Boschi, A., 15:38169
Sasakawa, T., Is there any quark effect seen in triton?, 15:37793 (RA;JP)
Sassi, M., *See* Andreani, R., 15:38160
Satkofsky, J., *See* Lawson, J.E., 15:38246
Sattison, M.B., *See* Russell, K.D., 15:36980
Savoie, F.E., *See* Liu, Y.Y., 15:36961
Sawada, Y., *See* Shimada, M., 15:38188
Sawan, M.E., Activation analysis for the LIBRA light ion beam fusion conceptual design, 15:38222 (RA;US)
See Emmert, G.A., 15:38163
See Khater, H.Y., 15:38233
See Sviatoslavsky, I.N., 15:38234
Sawy, A.E., *See* Gray, D., 15:36702
Saxonis, W.P., Program evaluation of the New York State Energy Efficient Appliance Rebate Demonstration Program: The free rider factor, 15:37081 (RA;US)
Scalapino, D.J., *See* Loh, E.Y. Jr., 15:38006
Scalettar, R.T., *See* Loh, E.Y. Jr., 15:38006
Scaramuzzi, F., *See* Martinis, L., 15:38198
Scarbrough, J.O., *See* Williams, R.K., 15:37355
Scarbrough, T.G., Action plans for motor-operated valves and check valves, 15:36974 (R;US)
Scarl, E., *See* Di Domenico, P., 15:36969
Scarlassara, F., *See* Kim, H.J., 15:37869
Schadler, G.H., *See* Weinberger, P., 15:37224
Schaefer, D., *See* Martin, J.E., 15:37318
Schaeffer, R.W., *See* Hill, D.J., 15:36956
Schaffer, A., First evidence for direct Cp violation, 15:37767 (R;FR)
Schaffer, M., *See* Smith, J.P., 15:38211
Schaich, C.R., *See* Schwenterly, S.W., 15:38140
Schanwald, L.P., *See* Bieg, K.W., 15:38261
See Zutavern, F.J., 15:37410
Schappert, G.T., *See* Casperson, D.E., 15:38296
Schechter, D.E., *See* Tsai, C.C., 15:37716, 15:38195
Scheffel, J., Extrap interchange stability, 15:38043 (R;SE)
Schillaci, M.E., *See* Gibson, B.F., 15:37763
Schirber, J.E., *See* McCarty, K.F., 15:37242
Schlegel, J., Toward a common method of reporting and comparing results from evaluations of residential conservation programs, 15:37093 (RA;US)
Schleisiek, K., *See* Bauer, T.H., 15:36938
Schlesinger, M.E., Research on CO_2-induced climate change: Final report, 15:37566 (R;US)
Schlesinger, T.E., *See* Bao, X.J., 15:37248
See Cammarata, R.C., 15:37205
Schlossman, M.L., *See* Schwartz, D.K., 15:37748
Schlottmann, P., *See* Sollie, R., 15:37220
Schlueter, R.O., Filtered vented containments, 15:36977 (RA;US)
Schluter, L.L., *See* Reda, D.C., 15:36881
Schluter, M., *See* Hybertsen, M.S., 15:37985
Schmeltzer, D., Anyons in the *XY* model induced by charged holes, 15:37973 (J;US)
Schmid, S., *See* Graf, J., 15:37584
Schmidt, G.L., Pellets in large tokamaks TFTR and JET, 15:38255 (R;US)
Schmidt, J.A., *See* Reiersen, W.T., 15:38194
Schmidt, J.W., Westinghouse Hanford Company environmental surveillance annual report – 200/600 Areas: Calendar year 1989, 15:37624 (R;US)
Schmidt, M.P., *See* Ohl, K.E., 15:37785
Schmitt, R.C., Transporting spent and damaged fuel in the United States: Recent experience and lessons learned related to the evolving transportation policy of the US Department of Energy, 15:36760 (R;US)
Schmitz, R.P., *See* Schlueter, R.O., 15:36977
Schmor, P.W., *See* Levy, C.D.P., 15:37500
Schneibel, J.H., *See* Hazzledine, P.M., 15:37179
See Sparks, C.J., 15:37180
Schnell, W., The study of a CERN linear collider, CLIC, 15:37438 (RA;US)
See Wilson, I., 15:37477
Schnieder, R.F., *See* Weidman, D.J., 15:38286
Schnitzer, H.J., *See* Kirsch, L.E., 15:37753
Schnurr, N.M., Thermal analysis of the CPFR/ZTH apparatus, 15:38137 (RA;US)
Schoch, P.M., *See* Schwelberger, J., 15:38073
Schoenberg, K.F., *See* Weber, P.G., 15:38063
Schoepfle, M., *See* Cantor, R., 15:37009
Scholten, O., *See* Meyer, R.A., 15:37914
Scholz, S., Production and decay of the τ lepton, 15:37777 (R;DE;In German)
Schopper, J.R., *See* Burkhardt, H., 15:36719
Schrage, D., A flight-qualified RFQ for the BEAR project, 15:37431 (RA;US)
Schubert, W.K., *See* Brower, K.L., 15:37309
Schuck, L., PG and E's value of residential services research, 15:37075 (RA;US)
See Train, K., 15:37057
Schueler, V., Integrating process and impact evaluation findings to modify the oil help rebate measure list, 15:37107 (RA;US)
Schuett, R., *See* Burkhardt, H., 15:36719
Schuler, R.H., *See* Sun, Q., 15:37370
Schuller, I.K., *See* Bjornholm, T., 15:37276
Schultz, K., *See* Gallix, R., 15:38128
Schultz, K.R., *See* Cheng, E.T., 15:38171
See Wong, C.P.C., 15:38154
Schultz, R., *See* Scott, M., 15:36710
Schulze, E., Dose-response-relationships for phytotoxic air pollutants, where no air quality standards have been established. Criteria for decision-making in special cases (TA Luft, 2.2.1.3), 15:37680 (R;DE;In German)
Schupp, G., Quasielastic γ-ray scattering from pentadecane, 15:37336 (J;US)
Schuresko, D.D., *See* Kozub, T.A., 15:38209
See Qualls, A.L., 15:38208
Schwalm, R.W., Use of fiber optic equipment for security: Electronic crime countermeasures, 15:37384 (BA;US)
Schwandt, P., *See* Glover, C.W., 15:37855
Schwartz, D.K., Thermal diffuse x-ray-scattering studies of the water-vapor interface, 15:37748 (J;US)
Schwartz, R.W., The effects of hydrolysis and additive conditions on the gel-to-ceramic conversion of sol-gel derived $PbTiO_3$, 15:37240 (R;US)
Schweitzer, M., Key issues in electric utility integrated resource planning: Findings from a nationwide study, 15:37038 (R;US)
Schwelberger, J., Design studies of the 2 mev heavy ion beam probe for text upgrade, 15:38073 (BA;US)
Schwenterly, S.W., Location and repair of air leaks in the ATF vacuum vessel, 15:38140 (RA;US)
Scime, E.E., *See* Beckstead, J.A., 15:38285
Scobel, W., Preequilibrium (p,n) reaction as a probe for the effective nucleon-nucleon interaction in multistep direct processes, 15:37863 (J;US)
See Blann, M., 15:37909
Scofield, M.P., *See* McElroy, D.L., 15:37123
Scott, A.M., Gain and noise characteristics of a Brillouin amplifier and their dependence on the spatial structure of the pump beam, 15:37542 (J;US)
Scott, M., Global energy and the greenhouse issue, 15:36710 (J;GB)
Scott, S.D., *See* Synakowski, E.J., 15:38034
Seager, C.H., *See* Brower, K.L., 15:37309
Seaman, C.L., *See* Weir, S.T., 15:37255
Sears, J., *See* Padamsee, H., 15:37470
Sears, T.J., *See* Fawzy, W.M., 15:37338
Seccamani, E., *See* Rhodes, B.A., 15:37647
Sedgley, D., *See* Walthers, C., 15:38135
Seeker, W.R., *See* Chen, S.L., 15:36709
Seeley, G., *See* Madan, B., 15:37364

Seeman, J., Determination of ϵ, β, α from an arbitrary number of beam size measurements, 15:37459 (R;US)
Seeman, J.T., Beam dynamics issues in linear colliders, 15:37462 (BA;US)
Segalman, D.J., *See* Feddema, J.T., 15:37382
Segers, R., *See* Lawson, J.E., 15:38246
Seidel, B.R., *See* Lahm, C.E., 15:36919
Seidensticker, R.W., *See* Kuroda, T., 15:36958
Seimiya, M., *See* Arakawa, K., 15:38158
Seka, W., *See* Mizuno, K., 15:38057, 15:38256
Selby, P.B., [Biological effects of atomic radiation]: Foreign trip report, May 11–19, 1989, 15:37671 (R;US)
Selkowitz, S., Evaluation of advanced glazing technologies, 15:37133 (BA;US)
Selman, J.R., Electrode reaction mechanisms in molten carbonate fuel cells: Final report, 15:37044 (R;US)
Semkow, T.M., *See* Nicolis, N.G., 15:37871
Sen, A., Transition metal mediated transformations of small molecules: Annual progress report, December 1, 1989–November 30, 1990, 15:37340 (R;US)
Sen, U., Turbulence studies of high pressure dynamic nitrogen arcs, 15:38059 (BA;US)
Serafini, L., *See* Ferrucci, L., 15:37480
Serinni, G., *See* Jeppson, D.W., 15:38173
Serio, M.A., *See* Solomon, P.R., 15:36716
Sessler, A.M., *See* Hopkins, D.B., 15:37483
See Whittum, D.H., 15:37422
Seth, K.K., Negative pion-nucleus elastic scattering at 30 and 50 MeV, 15:37860 (J;US)
Severin, D., Short path molecular distillation and extraction with gases in the supercritical state for improved characterization of petroleum residues, 15:36736 (R;DE;In German)
Sextro, R.G., *See* Turk, B.H., 15:37591
Shack, W.J., *See* Kassner, T.F., 15:36906
Shade, J.W., Viscosity, electrical conductivity, and cesium volatility of ORNL [Oak Ridge National Laboratory] vitrified soils with limestone and sodium additives, 15:36785 (R;US)
Shaffer, J.C., Measuring the value of customer service at Seattle City Light, 15:37074 (RA;US)
Shamsi, A., Study of eastern and weatern oil shale minerals activity for hydrodesulfurization (HDS) and hydrodenitrogenaton (HDN) reactions, 15:36755 (J;US)
Shankar, S., *See* Murr, L.E., 15:37203
Shankland, T.J., *See* Johnson, P.A., 15:37287
Shankle, S.A., *See* Klan, M.S., 15:37126
Shao, W., Magic-angle spinning ^{29}Si NMR study of short-range order in *a*-Si, 15:37326 (J;US)
Shapira, D., *See* Kim, H.J., 15:37869
Shapiro, S.L., Progress report on the use of hybrid silicon pin diode arrays in high energy physics, 15:37533 (R;US)
Sharafat, S., Silicon-carbide composite materials for the ARIES-I reactor study, 15:38216 (RA;US)
Sharifi, M.R., Effect of manipulation of water and nitrogen supplies on the quantitative phenology of Larrea tridentata (creosote bush) in the Sonoran desert in California, 15:37611 (J;US)
Sharitz, R.R., *See* Huenneke, L.F., 15:37608
Sharma, V., *See* Bortoletto, D., 15:37781
Sharon, A., *See* Malinovic, B., 15:36964
See Paik, Chan Y., 15:36968
Sharp, D.H., *See* Glimm, J., 15:37743
Sharp, J.K., Information engineering: Sandia's Computer Integrated Manufacturing (CIM) database, 15:38313 (R;US)
Sharp, R.D., *See* Rogers, G.O., 15:37560
Sharp, R.E., *See* Rao, I.M., 15:37642
Sharp, T.R., Measurement of energy performance in a small bank building, 15:37121 (R;US)
Sharpe, S.R., Chiral logarithms in quenched m_π and f_π, 15:37821 (J;US)
Shaw, C.B. Jr., Phenomenology, diagnostics, and non-LTE effects in plasma-particle interactions, 15:37332 (R;US)
Shcherbakov, A.A., *See* Gladkikh, P.I., 15:37435
Sheffield, R.L., *See* Tallerico, P.J., 15:37473
Shelton, R.N., *See* Bonner, B.P., 15:37278
See McCarty, K.F., 15:37266
Shen, B.C., *See* Daoudi, M., 15:37801
Shen, W., *See* Beckstead, J.A.. 15:38285
Shen, Y.R., *See* Zhu, X.D., 15:38002
Shendrik, V.A., *See* Gladkikh, P.I., 15:37435
Sherman, D.B., *See* Kinney, L.F., 15:37059
Sherman, R., *See* Anderson, J., 15:38105
Sherrod, K.C., *See* Donovan, L.A., 15:37628
Shi, D., Effect of microstructural changes on thermally activated flux-creep behavior in the Bi-Sr-Ca-Cu-O system, 15:37267 (J;US)
Transport critical current density and microstructure in extruded $YBa_2Cu_3O_{7-x}$ wires processed by zone melting, 15:37250 (J;US)
See Tan, Z., 15:37260
Shibui, M., Method for estimating failure probabilities of structural components and its application to fatigue problem of internally cooled superconductors, 15:38179 (RA;US)
Shields, J.C., *See* Dey, A, 15:37695
Shiho, M., *See* Oda, T., 15:38052
Shimada, M., Development of a forced-cooled superconducting coil for fusion applications, 15:38188 (RA;US)
Shimamoto, S., *See* Koizumi, K., 15:38178
Shimizu, M., *See* Arakawa, K., 15:38158
See Horiike, H., 15:38164
Shimohiro, D., *See* Yoshikawa, K., 15:38224
Shimomura, T., *See* Onozuka, M., 15:38200
Shinar, J., *See* Shao, W., 15:37326
Shinohara, A., Chemistry of pionic atoms, 15:37718 (RA;JP;In Japanese)
Shinohara, H., *See* Misaizu, F., 15:37357
Shinozaki, S., *See* Loring, M., 15:38252
See Moriyama, S., 15:38236
Shinpaugh, J.L., *See* Lee, D.H., 15:37728
Shipsey, I.P.J., *See* Bortoletto, D., 15:37781
Shirakata, H., *See* Arakawa, K., 15:38158
Shmayda, W.T., *See* Longhurst, G.R., 15:38107
Shoffstall, D.R., Visible wavelength free electron oscillator, 15:37555 (RA;US)
Shonder, J.A., *See* McLain, H.A., 15:37135
Shope, S.L., *See* Mazarakis, M.G., 15:37482
Shu, Q.S., *See* Padamsee, H., 15:37470
Shugart, L.R., TNT [trinitrotoluene] metabolites in animal tissues: Quarterly technical progress report No. 6, January 1–March 31, 1990, 15:37676 (R;US)
Shuskus, A.J., *See* Cooper, C.V., 15:37202
Sicre, A., *See* Boucheneb, N., 15:37892
Siddiqui, H.R., A comparative kinetic study of xenon adsorption on a flat Pt(111) and stepped Pt(557) and Pt(112) surfaces, 15:37366 (J;US)
Siddons, D.P., *See* Hastings, J.B., 15:37312, 15:37510
Siefken, L.J., Extensions to SCDAP/RELAP5/MOD2 debris analysis models for the severe accident analysis of Savannah River Site (SRS) reactors preliminary design report, 15:36967 (R;US)
Siegel, E.A., Fatigue degradation of nozzles and piping in a PWR reactor coolant system, 15:36994 (BA;US)
Siegel, M.D., *See* Bayley, S.E., 15:36788
Siegerist, B., *See* Maier-Reiter, W., 15:37681
Siemann, R.H., B-factories: A perspective of β-physics and possible accelerator design approaches, 15:37436 (RA;US)
Sigmon, C.F., Environmental compliance assessment findings for Weldon Spring Site Remedial Action Program, 15:36805 (R;US)
Sigmon, T.W., *See* Chang, Y., 15:37310
Sikka, V.K., *See* Alexander, D.J., 15:36690
Silbar, R.R., *See* Kloet, W.M., 15:37911
Silbey, R., Tunneling of molecules in low-temperature media: An elementary description, 15:37737 (J;US)
Silk, J.D., *See* Burger, W.J., 15:37866
Sils, I.V., *See* Szlyk, P.C., 15:37558
Silver, M.N., *See* Modine, F.A., 15:37252
Silvera, I.F., *See* Walsworth, R.L., 15:37722
Siminovitch, M., *See* Crawford, D., 15:37120
Simionovici, A., Precision spectroscopy of n=3 to n=2 transitions in Li-like and Be-like xenon, 15:37734 (J;US)
Simmons, G.J., *See* Ingemarsson, I., 15:38345
Simmons, G.W., *See* Klier, K., 15:37341

Simon, J., Photovoltaic conversion through thin films organic semiconductors, 15:36834 (R;FR;In French)
Simon, R.L., Results of a detailed field measurement program to evaluate micrositing tools, 15:36886 (BA;US)
Simonen, F.A., *See* Balkey, K.R., 15:36943
Simons, R.W., Hydric hammocks: A guide to management, 15:37594 (R;US)
Simpson, J.D., *See* Hoffer, J.K., 15:38260
Simpson, W.W., *See* Rochau, G.E., 15:38263
Sinda, T., *See* Abou Yehia, H., 15:36951
Singer, L.A., *See* Tseng, J.C.C., 15:37339
Singh, M.S., *See* Tobin, M.T., 15:38223
Singh, R.K., Pulsed-laser evaporation technique for deposition of thin films: Physics and theoretical model, 15:37971 (J;US)
Theoretical model for deposition of superconducting thin films using pulsed laser evaporation technique, 15:37251 (J;US)
Singh, S.P., *See* Wilson, J.H., 15:37612
Singham, M.K., *See* Koltun, D.S., 15:37912
Singkarat, Somsorn, Study of the multiple scattering effect in TEBENE using the Monte Carlo method, 15:37922 (R;SE)
Sinha, A., Bond-selected bimolecular chemistry: $H+HOD(4\nu_{OH}) \rightarrow OD+H_2$, 15:37354 (J;US)
Sissine, F., Making conservation profitable: Issues for regulation and evaluation, 15:37114 (RA;US)
Sissingh, R.A.P., *See* LaMarche, P.H., 15:38136
See Martin, G.D., 15:38138
Skaggs, B., B-Factory mechanical utilities operation without SLC, 15:37485 (R;US)
Skipper, M.N., Emergency preparedness at Oak Ridge National Laboratory, Oak Ridge, Tennessee, 15:36796 (R;US)
Skopec, M., *See* Calame, J., 15:38069
See Lawson, W., 15:37481
Skov Pedersen, J., *See* Als-Nielsen, J., 15:37952
Skwarnicki, T., *See* Bortoletto, D., 15:37781
Slack, D.S., Analysis of quench-vent pressures for present design of ITER [International Thermonuclear Experimental Reactor] TF [toroidal field] coils, 15:38100 (RA;US)
Recommendations for a cryogenic system for ITER (International Thermonuclear Experimental Reactor), 15:38181 (RA;US)
Slater, C.O., *See* Cramer, S.N., 15:37932
Slayman, C.L., Mechanisms and control of K^+ transport in plants and fungi, 15:37629 (R;US)
Slichter, C.P., *See* Monien, H., 15:37274
Sliwa, K., A new limit on the mass of the top quark, 15:37758 (R;US)
Sluiter, M., *See* Ceder, G., 15:37263
Slutz, S.A., Theory of multistage intense ion-beam acceleration, 15:37464 (J;US)
Smellie, J.A.T., *See* Ahlbom, K., 15:36791
Smit, F.J., Ultra-fine coal characterization: Final report, 15:36689 (R;US)
Smith, A.W., *See* Rohatgi, A., 15:37293
Smith, B.A., Evaluating utility direct load control programs: The duty cycle approach, 15:37071 (RA;US)
See Thorne, R.J., 15:38096
Smith, C.L., *See* Sanz, J.L., 15:37638
Smith, D., *See* Seth, K.K., 15:37860
Smith, D.L., Analysis and modelling of improved accelerating cavities for the Recirculating Linear Accelerator (RLA), 15:37458 (R;US)
See Mazarakis, M.G., 15:37482
Smith, H. Jr., *See* Balkey, K.R., 15:36943
Smith, J., *See* Baxi, C.B., 15:38133
Smith, J.L., *See* Cooke, D.W., 15:37259
Smith, J.P., Design of DIII-D advanced divertor, 15:38211 (RA;US)
Smith, N.S., *See* Fasching, G.E., 15:36712
Smith, P.D., *See* Vigil, A.S., 15:37550
Smith, R., *See* Price, D., 15:37556
Smith, R.L., *See* Ballard, E.O., 15:38111
Smith, R.R., *See* Levine, J.S., 15:38068
Smith, R.T.C., Design of the start experiment, 15:38117 (RA;US)
See Hayward, R.J., 15:38115
Smith, R.W., Syntheses and crystal structures of the α- and β-forms of the orthoborate $Sr_2Cu(BO_3)_2$, 15:37175 (J;US)
See Reda, D.C., 15:36881
Smith, T.L., *See* Burley, B.L., 15:38229
Snead, L.L., Center conductor design for the compact Spherical Torus reactor, 15:38126 (RA;US)
Snellman, M., Sampling and monitoring of carbon-14 in gaseous effluents from nuclear facilities: Literature survey, 15:36793 (R;FI)
Snow, W.M., *See* Sosnick, T.R., 15:37749
Snyder, S.C., *See* Shaw, C.B. Jr., 15:37332
Sobell, H.M., [Drug-DNA interactions studied by x-ray crystallography]: [Progress report], 15:37636 (R;US)
Sobotka, L.G., *See* Nicolis, N.G., 15:37871
Soederman, P., *See* Hakansson, A., 15:37859
Soerensen, B., Danish programs for efficient use of energy, 15:37068 (RA;US)
Soerensen, P., *See* Kunzendorf, H., 15:36743
Sokol, P.E., *See* Sosnick, T.R., 15:37749
Solano, E.R., *See* Li, G., 15:38302
Solbau, R.D., *See* Golf, F., 15:36864
Sollie, R., Frequency mixing in de Haas–van Alphen oscillations in heavy-fermion compounds, 15:37220 (J;US)
Solomon, P.R., New ignition phenomenon in coal combustion, 15:36716 (J;US)
Somsel, J., *See* Di Domenico, P., 15:36969
Sonato, P., *See* Baker, W.R., 15:38139
Sonder, E., *See* Thompson, J.R., 15:37976
Song Miaofa, *See* Fu Rongchu, 15:37562
Song, J., *See* Wessel, F.J., 15:38060
Song, Miyong, *See* Barker, L.E., 15:38317
Sonnenberg, K., *See* Kupschus, P., 15:38203
Sonnier, C.S., *See* Drayer, D.D., 15:36814
Soper, D.E., *See* Ellis, S.D., 15:37802
Soppet, W.K., *See* Kassner, T.F., 15:36906
Sorensen, J.H., *See* Rogers, G.O., 15:37560
Sorensen, S.P., *See* Plasil, F., 15:37881
Sosnick, T.R., Deep-inelastic neutron scattering from liquid ^4He, 15:37749 (J;US)
Souers, P.C., Deuteron polarization of solid DT, 15:38308 (J;US)
See Mapoles, E.R., 15:37974
See Wolfer, W.G., 15:37319
Soukoulis, C.M., *See* Li, Q., 15:37975
Southon, J.R., *See* Felton, J.S., 15:37653
Spampinato, P.T., Systems integration approach to developing component arrangements, the test facility, and maintenance for the Compact Ignition Tokamak, 15:38159 (RA;US)
Spang, W., *See* Morsch, H.P., 15:37877
Sparks, C.J., Formation of cubic LI_2 phases from Al_3Ti and Al_3Zr by transition metal substitutions for Al, 15:37180 (R;US)
Sperisen, F., *See* Goodwin, J.E., 15:37463
Spinka, H., *See* Glass, G., 15:37786
Spinner, B., ARC: Chemical heat pumps, 15:37125 (R;FR;In French)
Spitzig, W.A., *See* Trybus, C.L., 15:37254
Spitzmiller, D., Life Sciences Division and Center for Human Genome Studies Annual report 1989, 15:37637 (R;US)
Sprangle, P., Nonlinear interaction of intense laser pulses in plasmas, 15:38092 (J;US)
Nonlinear theory of intense laser-plasma interactions, 15:38305 (J;US)
Sprott, J.C., *See* Lovell, T.W., 15:38284
Srivastava, P.C., [Radiopharmaceutical chemistry]: Foreign trip report, June 28–July 9, 1988, 15:37652 (R;US)
Srivastava, Y.N., Topics in gauge theories and the unification of elementary particle interactions: Progress report, March 1, 1990–February 28, 1990, 15:37754 (R;US)
Srolovitz, D.J., *See* Hack, J.E., 15:37208
Staffler, R., Metal/graphite - composites in fusion engineering, 15:38134 (RA;US)
Staggs, M.C., *See* Kozlowski, M.R., 15:38273
Stallmann, F.W., PR-EDB: Power Reactor Embrittlement Data Base, version 1: Program description, 15:36907 (R;US)
Stanco, L., New DM2 results on $D/f_1(1285)$ and $\iota/\eta(1440)$, 15:37766 (R;FR)
Stanek, R., *See* Glass, G., 15:37786
Stanford, G.S., *See* Rhodes, E.A., 15:36954
Stanley, R.J., Ion dip spectroscopy of van der Waals clusters, 15:37337 (J;US)

Stanton, T.S., Energy program evaluation using P/G% decision-aiding software, 15:37104 (RA;US)
Statt, T.G., *See* Vineyard, E.A., 15:37130
Stearns, J.W., *See* Purgalis, P., 15:38238
See Wada, M., 15:37211
Stechel, E.B., *See* Hybertsen, M.S., 15:37985
Stein, J., *See* Avioli, M.J. Jr., 15:36934
See Kim, D.H., 15:37279
Steinberg, V., *See* Fineberg, J., 15:37391
Steiner, D., *See* Snead, L.L., 15:38126
Steinhardt, P.J., Hyperextended inflation, 15:37700 (J;US)
Stella, A., *See* Campostrini, P.P., 15:38230
Stelson, P.H., *See* Kim, H.J., 15:37869
Stencel, J.R., *See* Del Gandio, P., 15:38250
Stephanakis, S.J., *See* Young, F.C., 15:38301
Stephens, F.S., Spin alignment in superdeformed Hg nuclei, 15:37883 (J;US)
Stephenson, E.J., *See* Goodwin, J.E., 15:37463
Stephenson, G.J. Jr., *See* Maltman, K., 15:37917
Stern, S., *See* Laties, V.G., 15:37685
Sternlieb, B.J., Muon-spin-relaxation and neutron-scattering studies of magnetism in single-crystal $La_{1.94}Sr_{0.06}CuO_4$, 15:37268 (J;US)
Stevens, M.M., Conceptual model for radiological performance assessment of low-level-radioactive-waste disposal facilities, 15:36782 (R;US)
Stevens, R., *See* Foster, I., 15:38315
Stewart, C.C., *See* Salzman, G.C., 15:37640
Stewart, G.R., Elucidation of the specific-heat anomaly below T_N in $NpIr_2$, 15:37223 (J;US)
Stewart, K.A., *See* Baylor, L.R., 15:38245
Stewart, R.W., *See* Halford, V.E., 15:36778
Stinnett, R.W., *See* Prestwich, K.R., 15:38262
Stirling, W.J., *See* Harriman, P.N., 15:37789
Stirling, W.L., A neutral particle beam system for ITER with rf acceleration, 15:38239 (RA;US)
See Tsai, C.C., 15:37716
Stockley, R.L., *See* Tallerico, P.J., 15:37473
Stoeffl, W., *See* Decman, D.J., 15:37723
Stoffel, T., *See* Riordan, C., 15:36827
Stoffel, T.L., *See* Riordan, C.J., 15:36829
Stolen, R.H., *See* Hawkins, R.J., 15:37954
Stone, J.L., Thin film photovoltaic options: An overview, 15:36838 (BA;US)
Stork, D., *See* Bickley, A.J., 15:38253
Storm, R.S., *See* Boecker, W.D., 15:37237
Stovall, J., *See* Schrage, D., 15:37431
Stovall, T.K., Commercial cool storage laboratory test procedure, 15:37001 (R;US)
Strange, R., *See* Battle, P.D., 15:37167
Strathmann, H., *See* Baker, R.W., 15:37147, 15:37148
Stratton, B.C., Measurement of iron transport in TFTR [Tokamak Fusion Test Reactor] by charge exchange recombination spectroscopy, 15:38036 (R;US)
See Synakowski, E.J., 15:38034
Stratton, W.R., Review of the state of criticality of the Three Mile Island Unit 2 core and reactor vessel, 15:36966 (R;US)
Strickler, D.J., Equilibrium shape control in CIT PF design, 15:38123 (RA;US)
See Bartlit, J.R., 15:38151
See Peng, Y.K.M., 15:38014
Striffler, C.D., Numerical simulation of collective ion acceleration in the laser controlled collective accelerator, 15:38280 (BA;US)
See Lawson, W., 15:37481
Strongin, M., *See* Gao, Y., 15:37322
Struckmeyer, R., NRC TLD [thermoluminescent dosimeter] Direct Radiation Monitoring Network: Progress report, January–March 1990: Volume 10, No. 1, 15:36973 (R;US)
Stuchbery, A.E., *See* Dracoulis, G.D., 15:37873, 15:37875
See Fabricius, B., 15:37874
Stulen, R.H., *See* Bao, X.J., 15:37248
Stumpff, N.J., *See* Donovan, L.A., 15:37628
Stutler, W., *See* Hoenig, C., 15:37243
Stygar, W.A., *See* Leeper, R.J., 15:38040
See Sanford, T.W.L., 15:37445
Su, S., *See* Kim, Jinchoon, 15:38118
Subbarao, K., How to evaluate a building from short-term tests, 15:37132 (BA;US)
Sueker, J., *See* Ozog, M., 15:37069
Sugar, R.L., *See* Loh, E.Y. Jr., 15:38006
Sugihara, Ryo, *See* Yamanaka, Kaoru, 15:38038
Sullivan, M., *See* Donald, M., 15:37454
Sullivan, T.M., *See* Pescatore, C., 15:36766
Sumi, D.H., Persistence of energy savings in Seattle City Light's residential weatherization program, 15:37091 (RA;US)
Sumida, R., *See* Daghighian, F., 15:37654
Summers, K.M., *See* Rich, D.C., 15:37641
Summers, M.A., High-average-power solid state lasers, 15:38269 (RA;US)
Summitt, R.L., *See* Carter, J.C. III, 15:36965
Sun, Q., A time-resolved Raman study of the reaction of OH radicals with p-phenylenediamine, 15:37370 (J;US)
Sun, Yang Ren, *See* Thompson, J.R., 15:37976
Sundaram, B., *See* Goggin, M.E., 15:38005
Sundelin, R.M., Superconducting RF for direct acceleration in TeV colliders, 15:37433 (RA;US)
Surano, K., *See* Kercher, J.R., 15:37586
Sviatoslavsky, I.N., Sirius-T, a symmetrically illuminated ICF tritium production facility, 15:38234 (RA;US)
See Emmert, G.A., 15:38163
See Santarius, J.F., 15:38155
Swain, R.L., *See* Nanstad, R.K., 15:37393
Swaja, R.E., [Radiation protection]: Foreign trip report, April 8–16, 1988, 15:37670 (R;US)
Sweeney, F.J., DOE/NE University Program in robotics for advanced reactors: Program plan, FY 1990–FY 1994, 15:37375 (R;US)
Sweeney, M.A., *See* Rochau, G.E., 15:38263
Sydora, R.D., Fluctuations and transport due to ion-temperature-gradient–driven instabilities, 15:38089 (J;US)
Syed, R., Non-random mixing and fast ion decoupling in lithium chloroborate superionic glasses: An ion dynamics computer simulation study, 15:37301 (BA;US)
Sykes, A., *See* Smith, R.T.C., 15:38117
Synakowski, E.J., Measurements of radial profiles of He^{2+} transport coefficients on TFTR [Tokamak Fusion Test Reactor], 15:38034 (R;US)
See Stratton, B.C., 15:38036
Szalewicz, K., Accurate alpha sticking fractions from improved calculations relevant for muon catalyzed fusion: Final report, 15:37709 (R;US)
Szarleta, E., *See* Cantor, R., 15:37009
Sze, D.K., Design integration of the ARIES-I tokamak reactor, 15:38153 (RA;US)
See Anderson, J., 15:38105
Sze, H., *See* Levine, J.S., 15:38068
Szklarz, G., *See* Augustin, J.E., 15:37764, 15:37765
Szlyk, P.C., Effects of a modified through-mask drinking system (MDS) on fluid intake during exercise in chemical protective gear. Report for January-May 1989, 15:37558 (R;US)
Szpunar, C.B., *See* Gillette, J.L., 15:36717

T

Tada, E., *See* Koizumi, K., 15:38178
See Nishi, M.F., 15:38098
See Okuno, K., 15:38104
Tadao, Nozaki, Detectors for the asymmetric B factory, 15:37524 (RA;JP;In Japanese)
Taddeucci, T.N., Zero-degree cross sections for the $^7Li(p,n)^7Be$(g.s.+0.43-MeV) reaction in the energy range 80–795 MeV, 15:37858 (J;US)
See Glover, C.W., 15:37855
Tajima, H., Silicon vertex detector, 15:37525 (RA;JP)
Takacs, P.Z., Figure and finish of grazing incidence mirrors, 15:37280 (R;US)
See Church, E.L., 15:37537
Takahashi, H., *See* Kozub, T.A., 15:38209

Takahashi, I., *See* Tsuneoka, M., 15:38192
Takahashi, Minoru, *See* Kawamata, Youichi, 15:38030
Takahashi, Y., *See* Nishi, M.F., 15:38098
See Okuno, K., 15:38104
Takai, H., *See* Lissauer, D., 15:37915
Takatsu, H., *See* Onozuka, M., 15:38200
Takeda, S., Test accelerator for linear collider, 15:37449 (BA;US)
Takeda, Yasutoshi, Test apparatus of GaAs spin polarized electron source at Nagoya University, 15:37487 (RA;JP)
Takeiri, Y., *See* Kaneko, O., 15:38240
Takeuchi, Hiroshi, *See* Nagashima, Keisuke, 15:38029
Takeuchi, M., *See* Tsuneoka, M., 15:38192
Takiyama, K., *See* Mizuno, K., 15:38079
See Oda, T., 15:38052
Talaat, M.E., Radiofrequency ionization of helium with turbulent flow-measurements versus theory, 15:38289 (BA;US)
Tallant, D.R., *See* Osborne, Z.A., 15:37292
Tallerico, P.J., An RF-driven lasertron, 15:37473 (RA;US)
Tamai, Kunio, B meson decay in LUND 6.3, 15:37762 (RA;JP)
Tamano, T., Research operations on reversed field pinch: Final report, February 12, 1986–January 31, 1988, 15:38259 (R;US)
Tan, Z., Strontium-induced oxygen defect structure and hole doping in $La_{2-x}Sr_xCuO_4$ (B), 15:37260 (J;US)
Tanaka, Kichizo, *See* Naruse, Yuji, 15:38106
Tanaka, M., Construction of the RCNP polarized heavy ion source, 'HISPANIOLA', 15:37498 (RA;JP)
Tanaka, N., *See* Onozuka, M., 15:38200
Tanaka, Syo, *See* Kawai, Takeshi, 15:37928
Tang, Jinke, Searching for heavy fermion materials in Ce intermetallic compounds, 15:37189 (R;US)
Tang, P., The linearized gauge field propagator in an inhomogeneous medium, 15:37808 (J;US)
Tang, X., Multiphoton ionization of magnesium with configuration-interaction calculations, 15:37735 (J;US)
Tanga, A., The control of plasma parameters to avoid high current disruptions in JET, 15:38012 (RA;US)
Tannenbaum, B., *See* Van Liere, K.D., 15:37106
Tannous, C., *See* Houee-Levin, C., 15:37358
Tapster, P., *See* Scott, A.M., 15:37542
Tasso, H., *See* Camargo, S.J., 15:38026
Tautz, M., *See* Morgan, M.A., 15:38278
Taylor, B.J., *See* Stallmann, F.W., 15:36907
Taylor, G., *See* Stratton, B.C., 15:38036
See Synakowski, E.J., 15:38034
Taylor, L.M., *See* Preece, D.S., 15:36754
Taylor, R.P., The oxidative coupling of methane by lanthanum oxide catalysts: The influence of phase morphology on catalytic properties, 15:37350 (R;US)
Taylor, R.W., *See* Burnham, A.K., 15:36739
Teitel, S., *See* Li, Y., 15:37750
Telschow, K.L., NDE [nondestructive evaluation] of critical currents in high T_c superconductors, 15:37233 (R;US)
Real-time monitoring of ceramic sintering with laser ultrasonics, 15:37231 (R;US)
See Walter, J.B., 15:37232
Tendler, M., Poloidal rotation asymmetry and electric field effects at the edge of a divertor TOKAMAK, 15:38042 (R;SE)
See Rozhansky, V., 15:38047
Teng, Z., *See* Bars, I., 15:37996
Tennery, V.J., *See* Jenkins, M.G., 15:37229
Tennfors, E., Ion heat conduction losses in Extrap, 15:38044 (R;SE)
Tentner, A.M., Analysis of metal fuel transient overpower experiments with the SAS4A accident analysis code, 15:36918 (R;US)
Teotia, A.P.S., *See* Larsen, R.P., 15:37156
Terakado, M., *See* Loring, M., 15:38252
See Moriyama, S., 15:38236
Terasawa, Tokuo, Light ion reaction, 15:37905 (RA;JP;In Japanese)
Terner, T.F., *See* Miknis, F.P., 15:36758
Ternes, M.P., Measured space-cooling electricity savings from standard energy conservation measures, radiant barriers, and high-efficiency window air conditioners, 15:37118 (R;US)
Terry, D.R., Control system for the Texas Experimental Tokamak ECRH system, 15:38242 (RA;US)
See Pavlovsky, D.A., 15:38235
Terry, F.L., *See* Drummond, T.J., 15:37296
Tesar, D., *See* Sweeney, F.J., 15:37375
Tharion, W.J., *See* Szlyk, P.C., 15:37558
The CYGNUS Collaboration, *See* Goodman, J.A., 15:37699
The GRANDE Collaboration, *See* Goodman, J.A., 15:37699
Theobald, J., *See* Carjan, N., 15:37891
Theron, G., Ultrasonic signal processing and B-SCAN imaging for nondestructive testing. Application to under - cladding - cracks, 15:36936 (R;FR;In French)
Thiel, J.P., *See* Li, D.J., 15:37163
Thomas, A.L., *See* Hoeksema, R.J., 15:37627
Thomas, C.O., *See* Wilson, J.H., 15:37612
Thomas, G., *See* Koestler, C., 15:37209
See Ramesh, R., 15:37212
Thomas, J.B., Software supervisor: extension to the on-line codes utilization in order to help the process control, 15:38314 (R;FR;In French)
Thomas, P., *See* Thome, R.J., 15:38096
See Winn, P., 15:38097
Thome, R.J., Design and R and D for the central solenoid for the Compact Ignition Tokamak (CIT), 15:38096 (RA;US)
See Pillsbury, R.D. Jr., 15:38099
See Vieira, R., 15:38095
See Winn, P., 15:38097
Thompson, C.V., *See* Matthews, T.G., 15:37137
Thompson, J.R., Evidence of weak pair coupling in the penetration depth of bi-based high-T_c superconductors, 15:37976 (R;US)
See Christen, D.K., 15:37228
Thompson, R.B., *See* Li, Y., 15:37998
Thompson, R.E., *See* Muzio, L.J., 15:36897
Thorne, B.J., Experimental and computational investigation of the fundamental mechanisms of cratering, 15:37399 (R;US)
Thorstenson, D.C., Physical and chemical characteristics of topographically affected airflow in an open borehole at Yucca Mountain, Nevada, 15:36771 (R;US)
Thovert, J.F., Bounds on the effective properties of polydispersed suspensions of spheres: An evaluation of two relevant morphological parameters, 15:37968 (J;US)
Thruston, G., *See* Smith, J.P., 15:38211
Thulasidas, M., *See* Bortoletto, D., 15:37781
Thullen, P., *See* Hammer, C.F., 15:38156
Thurgood, P., PC-Link historical data base system MODCOMP/IBM at link for neutral particle beam operation, 15:38243 (RA;US)
Thurston, T.R., *See* Sternlieb, B.J., 15:37268
Tichenor, D.A., *See* McCrory, F.M., 15:36949
Ticknor, M., *See* Nadel, S., 15:37063
Tidwell, S.C., Generating radially polarized beams interferometrically, 15:37419 (J;US)
Tien, C.L., *See* Reilly, S., 15:37389
Timberlake, J., *See* Stratton, B.C., 15:38036
Tincknell, M.L., *See* Plasil, F., 15:37881
Ting, A., *See* Sprangle, P., 15:38092, 15:38305
Tiong, K.K., A sixteenth harmonic cusptron oscillator, 15:38071 (BA;US)
Tischler, J.Z., *See* Larson, B.C., 15:37538
Tisone, G.C., *See* Bieg, K.W., 15:38261
Titus, P., *See* Ballinger, R., 15:38219
See Thome, R.J., 15:38096
Tivey, R.B., *See* Altmann, H., 15:38131
Tjon, J.A., *See* Kloet, W.M., 15:37911
Tobin, M.T., ICF applications studies, 15:38270 (RA;US)
Laboratory microfusion facility - Neutronics and radiological safety analysis, 15:38223 (RA;US)
Neutronics issues for starlight: An inertial confinement fusion reactor concept, 15:38251 (RA;US)
Todd, T.N., *See* Smith, R.T.C., 15:38117
Toennies, V., *See* Burkhardt, H., 15:36719
Toerroenen, K., *See* Wallin, K., 15:37199
Toigo, V., *See* Campostrini, P.P., 15:38230
See De Lorenzi, A., 15:38205
Toki, H., Delta isobar in (h,t) reactions, 15:37903 (RA;JP)
Toku, Hisayuki, *See* Yamamoto, Yasushi, 15:38162
Tomlinson, J.J., Analysis of wallboard containing a phase change material, 15:37116 (R;US)

See Stovall, T.K., 15:37001
Tong, Y.-C., *See* Osborne, M.F., 15:36944
Topudurti, K., *See* Welshans, G., 15:37619
Torikachvili, M.S., *See* Allen, J.W., 15:37271
Torquato, S., Relationship between permeability and diffusion-controlled trapping constant of porous media, 15:37745 (J;US)
See Thovert, J.F., 15:37968
Torrance, J.B., *See* Amato, A., 15:37980
Torrison, L.L., *See* Wilson, J.M., 15:37446
Tosa, Y., *See* Lundell, A.T., 15:37995
Toth, K.S., [The decay properties of neutron-deficient hafnium isotopes]: Foreign trip report, May 19, 1990–May 31, 1990, 15:37876 (R;US)
Toulhoat, H., *See* Houssenbay, S., 15:37215
Touryan, K.J., *See* Rodriguez, A.E., 15:38066
Tow, D.M., *See* Rodriguez, J.G., 15:37394
Trabandt, M., *See* Blann, M., 15:37909
See Scobel, W., 15:37863
Traeger, R.K., The greenhouse effect and acid rain: A tutorial, 15:37580 (R;US)
Train, K., Impact evaluation of project HELP: Direct weatherization for low-income, elderly, and handicapped customers, 15:37057 (RA;US)
Train, K.E., *See* Dagang, D.A., 15:37087
Trainor, M.S., *See* Alexander, J.B., 15:38343
Tratnik, M.V., Multivariable biorthogonal continuous–discrete Wilson and Racah polynomials, 15:37997 (J;US)
Travis, C.C., [Environmental toxicology]: Foreign trip report, November 11–21, 1988, 15:37674 (R;US)
Travis, J.R., *See* Osborne, M.F., 15:36944
Trcka, D.E., Angular momentum dependent absorption in ^{6}Li scattering, 15:37853 (J;US)
Treacy, P.B., *See* Hay, H.J., 15:37708
Trent, B.C., *See* DeVault, G.P., 15:37551
Trentadue, L., *See* Bonvicini, G., 15:37798
Tripathi, G.N.R., *See* Sun, Q., 15:37370
Trivedi, M.M., *See* Sweeney, F.J., 15:37375
Triveipiece, A.W., Balancing the roles for conservation, coal, nuclear, and other energy systems, 15:37026 (R;US)
International aspects of Oak Ridge National Laboratory, 15:37024 (R;US)
Training scientists and engineers for the year 2000: Testimony before the Subcommittee on Science, Technology, and Space , Committee on Commerce, Science, and Transportation, United States Senate, 15:37154 (R;US)
Tronc, E., Structural and spectroscopic investigations of $LaFeAl_{11}O_{19}$ compounds, 15:37165 (J;US)
Trousslot, F., *See* Guesnier, B., 15:37006
Troxell, J.D., GlidCop dispersion strengthened copper: Potential applications in fusion power generators, 15:38103 (RA;US)
Trujillo, P.E. Jr., *See* Adams, A., 15:36862
See Golf, F., 15:36864
Trybus, C.L., Characterization of the strength and microstructural evolution of a heavily cold rolled Cu-20% Nb composite, 15:37254 (J;US)
Tryk, D.A., *See* Selman, J.R., 15:37044
Tsai, C.C., Characteristics of an electron-beam rocket pellet accelerator, 15:38195 (RA;US)
Potential applications of an electron cyclotron resonance multicusp plasma source, 15:37716 (R;US)
See Gouge, M.J., 15:38204
Tsai, H.C., *See* Liu, Y.Y., 15:36961
Tsai, Hanchung, Fuel/cladding compatibility in irradiated metallic fuel pins at elevated temperatures, 15:36920 (R;US)
Tsang, M.N., *See* Harris, T.L., 15:37283
Tseng, J.C.C., Structure-energy correlation of the intramolecular charge-transfer state in a series of (N,N-diethylanilino) arenes, 15:37339 (J;US)
Tsugawa, R.T., *See* Wolfer, W.G., 15:37319
Tsuji, H., *See* Koizumi, K., 15:38178
See Nishi, M.F., 15:38098
See Okuno, K., 15:38104
Tsuneoka, M., The design of RF power supply using DC-DC converter, 15:38192 (RA;US)
Tsuo, Y.S., Hydrogen-plasma reactive flushing for a Si:H p-i-n solar cell fabrication, 15:36841 (BA;US)
Tubbing, B., *See* Tanga, A., 15:38012
Tuchsen, D., *See* Rhodes, B.A., 15:37646
Tucker, R., *See* Carrera, R., 15:38207
Tuckerman, D.B., *See* Bernhardt, A.F., 15:37958
See Marella, P.F., 15:37957
Tufts, B.J., *See* Kumar, A., 15:36842
Tulenko, J.S., *See* Sweeney, F.J., 15:37375
Tuller, H.L., *See* Fusco, F.A., 15:37303
See Moon, P.K., 15:37246
Tunnell, T.W., [Workshop on artificially ionized layers in the atmosphere]: Foreign trip report, October 5–14, 1989, 15:37568 (R;US)
Tuntomo, A., *See* Reilly, S., 15:37389
Tur, Yu.D., *See* Gladkikh, P.I., 15:37435
Turk, B.H., Characterizing the occurrence, sources, and variability of radon in pacific northwest homes, 15:37591 (J;US)
Turman, B.N., *See* Harjes, H.C., 15:37411
See Smith, D.L., 15:37458
Turner, M.S., *See* Frieman, J.A., 15:37703
Turner, W.C., *See* Nexsen, W.E., 15:37504
Turteltaub, K.W., *See* Felton, J.S., 15:37653
Tveten, U., Review of the chronic exposure pathways models in MACCS [MELCOR Accident Consequence Code System] and several other well-known probabilistic risk assessment models, 15:37599 (R;US)
Tyndall, R.L., Free-living amoebae: Health concerns in the indoor environment, 15:37655 (R;US)
Tzanos, C.P., Analysis of a DRACS [Direct Reactor Auxiliary Cooling System] test COMMIX validation, 15:36922 (R;US)

U

Ueda, Tamotsu, pd-^{3}He $\pi^{0}(t\pi^{+})$ reaction and NNΔ resonance, 15:37846 (RA;JP;In Japanese)
Uemura, Y.J., *See* Sternlieb, B.J., 15:37268
Ugaki, S.N., *See* O'Brien, M.H., 15:38257
Uhl, J.E., *See* Duda, L.E., 15:37536
Uhlemann, R., *See* Euringer, H., 15:38143
Uhm, H.S., *See* Chen, H.C., 15:38300
Uhrig, R.E., *See* Carter, R.J., 15:36939
Ulial, H.S., *See* Tsuo, Y.S., 15:36841
Ulmer, P., *See* Kelly, J.J., 15:37857
Ulrich, B., *See* Bredemeier, M., 15:37622
Ulrickson, M., *See* Barnes, G.W., 15:38147
Umoto, J., *See* Yoshikawa, K., 15:38224
Uno, Masahiro, Trends in atomic mass studies and comparisons of masses, Q-values, etc. of unstable nuclei, 15:37904 (RA;JP;In Japanese)
Uppuluri, V.R.R., A decision support system based on stochastic comparisons, 15:38316 (R;US)
[Symposium on the Analytic Hierarchy Process]: Foreign trip report, September 2, 1988–September 11, 1988, 15:38325 (R;US)
Utsuro, Masahiko, General report on UCN facility experiment, 15:37927 (RA;JP;In Japanese)
Installation and performance tests of KUR cold neutron source, 1: Structure and safety design, 15:36948 (RA;JP;In Japanese)
See Kawai, Takeshi, 15:37928

V

Vacanti, G., Gamma-ray astronomy at 1 TeV, 15:37697 (J;US)
Vagins, M.R., *See* Ohl, K.E., 15:37785
Vahala, L.L., Application of the results of carbon pellet modeling to the problem of plasma penetration, 15:38017 (R;US)
Valette, F., Adaptation and experimentation of management and physical economy models to the problems of the regional energy planning, 15:37007 (R;FR;In French)
Valladares, C.E., *See* Basu, S., 15:37704
Valo, M., *See* Wallin, K., 15:37199
Van Berkel, G.J., Geoporphyrin analysis using an ion trap mass spectrometer, 15:36721 (J;US)

Van Breugel, W.J.M., *See* Dey, A, 15:37695
Van Dam, J., *See* Montalvo, E., 15:38011
van den Berg, L., *See* Gerrish, V., 15:37517
van den Brandt, B., *See* Bosshard, A., 15:37784
van der Laan, G., *See* Lytle, F.W., 15:37221
Van Eeckhout, E., *See* Dennis, B., 15:36861
van Huisteyn, D.B., Principles of superconductor imaging surface gradiometry, 15:37978 (R;US)
See Overton, W.C. Jr., 15:37406
Van Liere, K., *See* McKellar, B.J., 15:37073
Van Liere, K.D., Comparison of alternative segmentation approaches for residential customers, 15:37110 (RA;US)
Factors affecting response rates in commercial and industrial customer surveys, 15:37106 (RA;US)
Van Orden, J.W., *See* Gross, F., 15:37910
Van Rooyen, D., An initial comparison of pitting resistance of alloys for potential geothermal applications, 15:36869 (R;US)
van Tuinen, P., *See* Rich, D.C., 15:37641
Van Tuyl, H.H., Interim report on low-cost cesium radiation sources from Hanford Waste Management Program, 15:36815 (R;US)
Van Tuyle, G.J., Simplified analysis of PRISM RVACS [Reactor Vessel Auxiliary Cooling System] performance without liner spillover, 15:36914 (R;US)
Vanacken, J., *See* Bjornholm, T., 15:37276
Vandergriff, K.U., Designing equipment for use in gamma radiation environments, 15:36759 (R;US)
Vandermolen, R.I., *See* McElhaney, S.A., 15:37530
Varadarajan, V., *See* Hu, S., 15:38291
Varner, R.L., *See* Auble, R.L., 15:37889
See Morsch, H.P., 15:37877
Vashishta, P., Molecular dynamics simulation of mass and charge transport in superionic conductors, and structural correlations in chalcogenide glasses, 15:37300 (BA;US)
Vassiliou, J.K., Synthesis and properties of $NdNiO_3$ prepared by low-temperature methods, 15:37166 (J;US)
Vaughn, M.T., *See* Srivastava, Y.N., 15:37754
Vawter, G.A., Low threshold current implanted-planar buried-heterostructure graded-index separate confinement heterostructure laser in GaAs/AlGaAs, 15:37418 (J;US)
Vedadi, A., *See* Miller, J.R., 15:37089
Vehanen, A., *See* Henderson, S.D., 15:37825
Vemulapati, U.B., *See* Barlow, J.L., 15:38330
Venkatesh, M.C., *See* Anderson, P.M., 15:38227
Venkateswaran, V., *See* Boecker, W.D., 15:37237
Venneri, F., *See* Kim, Kyekyoon, 15:38212
Venturini, E.L., Strongly enhanced flux pinning by high-energy proton irradiation of a $Tl_2Ca_2Ba_2Cu_3O_y$ single crystal, 15:37258 (J;US)
See Ginley, D.S., 15:37261
See Samara, G.A., 15:37270
Verderber, R., *See* Crawford, D., 15:37120
Verdon, C.P., *See* Delettrez, J., 15:38306
Verma, S.K., *See* Vesely, E.J., 15:37201
Vernon, M.E., *See* McCrory, F.M., 15:36949
Vesely, E.J., The use of high power lasers in surface modifications, 15:37201 (BA;US)
Vessot, R.F.C., *See* Walsworth, R.L., 15:37722
Vickers, D., *See* Schlesinger, M.E., 15:37566
Videbaek, F., Charged particle distributions in heavy ion collisions at 14.6 GeV A/c, 15:37824 (R;US)
Viecelli, J., *See* Karr, T., 15:37742
Viecelli, J.A., Stimulated thermal Rayleigh scattering threshold induced by velocity turbulence, 15:37706 (J;US)
Vieira, R., Evaluation of alumina dispersion strengthened (ODS) copper for possible use in the central solenoid and TF coils for the compact ignition tokamak (CIT), 15:38095 (RA;US)
See Thome, R.J., 15:38096
Viennot, P., *See* Iris, P., 15:36872
Vieno, T., Safety and cost evaluation of nuclear waste management, 15:36794 (R;FI;In Finnish)
See Poteri, A., 15:36792
Vieth, P.H., *See* Kiefner, J.F., 15:36749
Vigil, A.S., High explosives skid impact initiation study, 15:37550 (R;US)
Vilim, R.B., A measurement-based method for predicting margins and uncertainties for unprotected accidents in the Integral Fast Reactor concept, 15:36960 (R;US)
Design of a reactor inlet temperature controller for EBR-2 using state feedback, 15:36937 (R;US)
The passive response of the Integral Fast Reactor concept to the chilled inlet accident, 15:36962 (R;US)
Vin, H.M., *See* Mattson, J.S. Jr., 15:38336
Vince, S.W., *See* Simons, R.W., 15:37594
Vincent, R.J., A magnetically coupled Stirling engine driven heat pump: Design optimization and operating cost analysis, 15:37143 (R;US)
Vine, E., Evaluating energy and non-energy impacts of energy conservation programs: A supply curve framework of analysis, 15:37102 (RA;US)
Vineyard, E.A., Selection of ozone-safe, nonazeotropic refrigerant mixtures for capacity modulation in residential heat pumps, 15:37130 (BA;US)
Violet, C.E., *See* Lytle, F.W., 15:37221
Violette, D., Correction for self-selection bias: Theory and application, 15:37082 (RA;US)
See Ozog, M., 15:37069
Virginia, R.A., *See* Sharifi, M.R., 15:37611
Virmont, J., *See* Gresillon, D., 15:38025
Vivien, D., *See* Tronc, E., 15:37165
Vlad, P.M., *See* Pezzimenti, D.M., 15:36775
Vogel, J.S., *See* Felton, J.S., 15:37653
Von Dreele, R.B., Texture of materials by time-of-flight neutron diffraction, 15:37191 (R;US)
von Przewoski, B., *See* Goodwin, J.E., 15:37463
VonHalle, A., *See* Dahlgren, F., 15:38186
Vories, R., Assessment of state needs for information and technical assistance in planning and evaluating residential energy conservation programs, 15:37099 (RA;US)
Voruganti, P., Fermions and solitons in the O(3) nonlinear σ model in 2+1 space-time dimensions, 15:37983 (J;US)
Voss, R.E., *See* Hertzer, D.R., 15:36799
Vuataz, F.D., *See* Sabroux, J.C., 15:36865
Vuillemin, H., *See* Notin, C., 15:36876
Vyas, A.D., *See* Larsen, R.P., 15:37156

W

Wada, M., Dependence of H^- production upon the work function of a Mo surface in a cesiated hydrogen discharge, 15:37211 (J;US)
Wahabou, A., Group contribution method for correlating and forecasting thermodynamic properties of petroleum fluids, 15:36738 (R;FR;In French)
Wai, P.K.A., *See* Chen, C., 15:37540
Waldron, W.D., *See* Vincent, R.J., 15:37143
Walford, F., *See* Drayer, D.D., 15:36814
Walker, E., *See* Amato, A., 15:37288, 15:37979
Walker, G., Ross-Stirling engines: Variations on a theme, 15:37400 (R;CA)
See Doige, A.G., 15:37401
Walker, G.A., Ab initio SCF studies of the electronic structures of halogen nitrates. 2. FNO_x (x = 1, 2, 3), 15:37593 (J;US)
Walker, H.A., *See* Davidson, J.H., 15:36858
Walker, R.A., The significance of local hard zones on the outside of pipeline girth welds: Final report, 15:36735 (R;GB)
Wall, J.D., Genetics and molecular biology of hydrogen metabolism in sulfate reducing bacteria: Progress report, May 1, 1987–December 1, 1989, 15:36819 (R;US)
Wallin, K., Characteristics of the IAEA correlation monitor material for surveillance programmes, 15:37199 (R;FI)
Walls, A., *See* Montalvo, E., 15:38116
Walls, J.C., *See* Hammonds, C.J., 15:38237
Walls, W.A., *See* Carrera, R., 15:38207
Walsh, J., *See* Gettelfinger, G., 15:38185
Walsh, R.W., Utilization of residential energy conservation program evaluation in least-cost utility planning, 15:37067 (RA;US)
Walsworth, R.L., Test of the linearity of quantum mechanics in an atomic system with a hydrogen maser, 15:37722 (J;US)

Waltar, A.E., *See* Padilla, A. Jr., 15:36928
Walter, J.B., Laser ultrasonic measurements on ceramic materials with rough surfaces, 15:37232 (R;US)
Walter, R.L., *See* Pedroni, R.S., 15:37872
Walthers, C., Co-pumping of deuterium-helium and tritium-helium mixtures at TSTA, 15:38135 (RA;US)
Walton, G.R., Radiation safety management during a TFTR shutdown, 15:38249 (RA;US)
See Gettelfinger, G., 15:38185
Walton, R.A., *See* Filbert, P.C., 15:38076
Wang Shouzhong, *See* Zheng Hualing, 15:37367
Wang, C.R., *See* Rocco, R.E., 15:38125
Wang, D., *See* Glover, C.W., 15:37855
Wang, E., Quasi-two-dimensional electronic properties of the monophosphate tungsten bronzes $Na_xP_4W_8O_{32}$ and $Na_xP_4W_{12}O_{44}$: Crystal growth, physical properties, and electronic band structure, 15:37164 (J;US)
Wang, J.C., Hopping model for the non-debye dielectric response in ionic crystals, 15:37302 (BA;US)
Wang, T., *See* Sale, K.E., 15:37856
Wang, T.F., *See* Sanders, S.J., 15:37862
Wang, W., *See* Lawson, W., 15:37481
Wang, Wei-Chyung, *See* Gutowski, W.J., 15:37565
Wang, Y., *See* Huels, M.A., 15:37731
Wang, Y.J., Relativistic effects on the $s \rightarrow d$ promotion energy and spin-polarization energy of the transition metals, 15:37724 (J;US)
Wang, Yarw-Nan, *See* Klier, K., 15:37341
Wangler, T., *See* Schrage, D., 15:37431
Ward, B.F.L., *See* Jadach, S., 15:37795
Ward, D.J., *See* Bathke, C.G., 15:38145
Ware, A.A., Neoclassical transport of toroidal momentum in tokamaks, 15:38091 (J;US)
Ware, A.G., Aging considerations for pressurizers in nuclear power plants, 15:36993 (BA;US)
Warner, K.L., Evaluation of California's Energy efficient building standards: The residential building monitoring project, 15:37111 (RA;US)
Warren, J.G., *See* Reddan, W.G., 15:38141
Warren, W.E., *See* Allred, R.E., 15:37295
Washburn, J., *See* Liliental-Weber, Z., 15:37421
Watanabe, N., Proceedings of the second workshop of Japan-UK collaboration on neutron scattering research, 15:37945 (R;JP)
Watanabe, Y., *See* Kaneko, O., 15:38240
Watkins, D., *See* Scott, A.M., 15:37542
Watness, K., *See* Harrison, F.L., 15:37682
Watson, A.P., Reentry planning: The technical basis for offsite recovery following warfare agent contamination, 15:37561 (R;US)
See Rogers, G.O., 15:37560
Weakley, S.A., The Residential Building Characteristics On-Site Inspection: Summary report, 15:37127 (R;US)
Weare, J.H., UCSD geothermal chemistry program: Annual progress report, FY 1989, 15:36874 (R;US)
Weaver, J.H., *See* Liliental-Weber, Z., 15:37421
Weaver, L.A., Sixth annual Gatlinburg acid rain conference: Proceedings, 15:37679 (R;US)
Weaver, M.J., *See* Leung, Lam-Wing H., 15:37219
Webb, S.W., A model for transient natural convection in a vertical cylinder with sidewall heating, 15:36720 (R;US)
Webber, S.E., *See* Bard, A.J., 15:37291
Weber, E.J., *See* Basu, S., 15:37704
Weber, E.R., *See* Liliental-Weber, Z., 15:37421
Weber, M., *See* Henderson, S.D., 15:37825
Weber, P.G., Confinement dynamics in the ZT-40M RFP, 15:38063 (BA;US)
Weber, S.V., Target design, 15:38265 (RA;US)
Webster, C.S., *See* Osborne, M.F., 15:36944
Wecker, J., *See* Koestler, C., 15:37209
Weeks, E.P., *See* Thorstenson, D.C., 15:36771
Wehe, D.K., *See* Sweeney, F.J., 15:37375
Wei, J.X., *See* Lestone, J.P., 15:37884
Wei, T.Y.C., *See* Cahalan, J.E., 15:36921
Weidman, D.J., Curve-fitting analysis of time-resolved Thomson spectrograms from a plasma focus, 15:38070 (BA;US)
Fast rise-time magnetic field coil study, 15:38286 (BA;US)
Weidner, H., Seepage into PEP tunnel, 15:37506 (R;US)
Weijden, C.H. van der, *See* Comans, R.M.J., 15:37602
Weinberger, P., Calculation of magnetic impurities in a nonmagnetic host: Fe in Au, 15:37224 (J;US)
Weinbrecht, E.A., *See* Harjes, H.C., 15:37411
Weiner, K.H., *See* Chang, Y., 15:37310
Weiner, R., *See* Kessel, C.E., 15:38146
Weingart, R.C., *See* Lee, R.S., 15:37553
Weingartner, K., *See* Carjan, N., 15:37891
Weir, A., *See* Atwood, W., 15:38334
Weir, S.T., Increase in the flux-pinning energy of $YBa_2Cu_3O_{7-\delta}$ by shock compaction, 15:37255 (J;US)
Weisberg, A.H., *See* Bernhardt, A.F., 15:37958
Weiss, M.S., *See* Berger, J.F., 15:37888
Weissenburger, D.W., Coupled eddy current and thermodynamic analysis with the SPARK code, 15:38177 (RA;US)
Weitzner, H., Plasma properties: Annual report, January 1, 1989–December 31, 1989, 15:38023 (R;US)
Welch, B.L., *See* Young, F.C., 15:38301
Welch, M.J., Positron Emission Tomography (PET): Final report, January 15, 1989–January 14, 1990, 15:37643 (R;US)
Weldon, W., *See* Montalvo, E., 15:38116
Weldon, W.F., *See* Carrera, R., 15:38207
See Hsieh, K.T., 15:38175
See Werst, M.D., 15:38293
Wellers, F., Inelastic events in nucleon-nucleon scattering experiments, 15:37890 (R;FR;In French)
Wellstood, F.C., Superconducting thin-film multiturn coils of $YBa_2Cu_3O_{7-x}$, 15:37420 (J;US)
Welsh, D., *See* Calame, J., 15:38069
See Lawson, W., 15:37481
Welshans, G., Technology evaluation report: SITE program demonstration of the Ultrox International ultraviolet radiation/oxidation technology, 15:37619 (R;US)
Welter, M.J., *See* Morris, G.J., 15:36715
Welty, C.S., *See* Avioli, M.J. Jr., 15:36934
Wemple, R.P., *See* Duda, L.E., 15:37536
Wen, X.G., Electrodynamical properties of gapless edge excitations in the fractional quantum Hall states, 15:37962 (J;US)
Wen, Y.J., *See* Brouchous, D., 15:38087
Wender, S.A., *See* Gibson, B.F., 15:37763
See Hakansson, A., 15:37859
Weng, R., *See* Drummond, T.J., 15:37296
Weng, Y., Including electron-electron collisions in Monte Carlo simulations of swarms in partially ionized plasmas, 15:38298 (BA;US)
Werber, K., *See* Ballinger, R., 15:38219
Werley, K.A., A high-speed beam of lithium droplets for collecting diverted energy and particles in ITER (International Thermonuclear Experimental Reactor), 15:38210 (RA;US)
Werst, M., *See* Carrera, R., 15:38207
Werst, M.D., High field, single turn toroidal magnet technology demonstrator for ignitex, 15:38293 (BA;US)
See Hsieh, K.T., 15:38175
Wesley, J.C., *See* Leuer, J.A., 15:38013
Wessel, F.J., Plasma motion into a transverse magnetic field and plasma, 15:38060 (BA;US)
Wessel, J., Biexcitonic autoionization in naphthalene trimer clusters, 15:37313 (J;US)
West, A.R., *See* Quintana, P., 15:37170
West, C.D., IGORR-1: Proceedings of the first meeting of the international group on research reactors, 15:36947 (R;US)
The advanced neutron source reactor: An overview, 15:36816 (R;US)
West, J.P., Electron-beam assisted CVD of silicon homoepitaxial films, 15:37959 (BA;US)
Westbrook, C.K., *See* Keller, J.O., 15:37397
Weyer, H., *See* Benfatto, I., 15:38221
Whang, M.H., *See* Kuo, S.P., 15:38055
Whang, S.H., High temperature superconducting compounds: Processing and related properties; Proceedings of the Symposium on High Temperature Superconducting Oxides: Processing and Related Properties, Las Vegas, NV, Feb. 27, 28, 1989, 15:37245 (B;US)
Whangbo, Myunghwan, *See* Wang, E., 15:37164

Whealton, J.H., *See* Becraft, W.R., 15:37432
See Stirling, W.L., 15:38239
Wheeler, R.B., *See* Modine, F.A., 15:37262
Whitbeck, J.F., *See* Dearien, J.A., 15:36925
White, D.L., Energy use and consumer dissimilarity in multifamily residential conservation, 15:37079 (RA;US)
See Vories, R., 15:37099
White, D.S., Demand-side management and economic development: A practical discussion, 15:37052 (RA;US)
The promotion of residential energy-efficient lighting: Results of Massachusetts Electric Company's Enterprise Zone Plan, 15:37105 (RA;US)
White, G.D., *See* Davies, K.T.R., 15:37994
White, J.E., Guidance and targeting for the strategic target system, 15:37557 (R;US)
White, S.R., *See* Loh, E.Y. Jr., 15:38006
Whitson, J., *See* Smith, R.T.C., 15:38117
Whitson, J.C., *See* Bartlit, J.R., 15:38151
See Peng, Y.K.M., 15:38014
Whittum, D.H., Ion-channel laser, 15:37422 (J;US)
Wiederhorn, S.M., *See* Carroll, D.F., 15:37253
Wiedey, G.A., *See* Bredemeier, M., 15:37622
Wieleczko, J.P., *See* Kim, H.J., 15:37869
Wigeland, R., *See* Cahalan, J., 15:36955
Wight, J., *See* Hong, R., 15:38142
Wilcox, B., *See* Warner, K.L., 15:37111
Wilcox, S., *See* Riordan, C., 15:36827
Wilcoxon, J.P., *See* Martin, J.E., 15:37318
Wilets, L., *See* Tang, P., 15:37808
Wilgen, J.B., *See* Qualls, A.L., 15:38208
Wilhelm, D., *See* Bohl, W.R., 15:36926
Wilk, R.D., The role of olefins in the autoignition chemistry of paraffinic hydrocarbons, 15:36740 (BA;US)
Wilke, G.D., *See* Powell, R.C., 15:37324
Wilkes, C., *See* Razdan, M.K., 15:36714
Wilkins, R.W., The design of the CPRF (Confinement Physics Research Facility) control system, 15:38244 (RA;US)
Wilkinson, N., *See* Levy, C.D.P., 15:37500
Williams, D.B., *See* Bateman, C.A., 15:37257
Williams, D.N., The use of flattened specimens to measure the Charpy V-notch impact properties of thin-wall pipe, 15:36746 (R;US)
See Cialone, H.J., 15:36748
Williams, F.A., *See* Margolis, S.B., 15:37390
Williams, F.R., *See* Mantz, H.C., 15:38132
Williams, L.S., Light-duty vehicle MPG [miles per gallon] and market shares report, Model year 1989, 15:37139 (R;US)
Williams, M., *See* Dahlgren, F., 15:38186
See McDade, J., 15:38241
Williams, R., Studies of injected particle trajectories in the beat wave accelerator, 15:38056 (BA;US)
Williams, R.K., Some observations of the effects of high pressures and temperatures on the stability of $YBa_2Cu_3O_{7-x}$, 15:37355 (J;US)
Williams, W.H., Nuclear-induced UV fluorescence, 15:37720 (BA;US)
Williamson, D.L., *See* Mahan, A.H., 15:37306
Williamson, M.A., Benchmarking of energy time series, 15:37008 (R;US)
Techniques for multivariate sample design, 15:36729 (R;US)
Willis, J.O., *See* Cooke, D.W., 15:37259
Wilms, R.S., Fusion fuel purification during the Tritium Systems Test Assembly 3-week loop experiment, 15:38101 (RA;US)
Wilmarth, P.A., *See* Nitschke, J.M., 15:37780
Wilson, D.G., [International conference on free and moving boundary problems]: Foreign trip report, October 9, 1988–October 23, 1988, 15:38327 (R;US)
Wilson, D.L., *See* Matthews, T.G., 15:37137
Wilson, I., Design and fabrication studies of high gradient accelerating structures for the CERN linear collider (CLIC), 15:37477 (RA;US)
Wilson, J.H., Advances in air-stripper technology, 15:37612 (R;US)
Wilson, J.M., The compact linear accelerator program at Sandia National Laboratories, 15:37446 (R;US)
Wilson, K.B., Performance analysis of a screenless (countercurrent) Granular Bed Filter on a subpilot-scale PFBC [pressurized fluidized-bed combustor], Volume 1: Final report, 15:36889 (R;US)
Wilson, M.T., *See* Tallerico, P.J., 15:37473
Wilson, P.B., SLAC R & D toward a TeV linear collider, 15:37440 (RA;US)
Wilson, R.J., Neutrino counting at e^+e^- colliders, 15:37800 (J;US)
Winger, J.A., $^{12}C(^{28}Si,X)^{11}C$ cross section at 13.4 GeV nucleon, 15:37861 (J;US)
Winkleman, B.C., Characterization of flow disturbances in a coal fired combustion flow train, 15:37040 (R;US)
Winn, P., Electrothermal evaluation of conductors for the Compact Ignition Tokamak (CIT) PF coils, 15:38097 (RA;US)
See Thome, R.J., 15:38096
Winter, C.J., Solar energy and hydrogen - for qualitative growth, 15:37005 (R;DE;In German)
Wisner, R.S., *See* Pahl, R.G., 15:36924
Witkowski, C.M., *See* Rich, D.C., 15:37641
Witt, R.J., *See* Emmert, G.A., 15:38163
Witte, P., The Michigan low-income weatherization energy education and incentives program, 15:37050 (RA;US)
See Kushler, M., 15:37098
Witten, M.A., *See* Mantz, H.C., 15:38132
Wittenberg, L.J., Pellet fueling of helium-3 enclosed in Li and Be shells, 15:38199 (RA;US)
See Emmert, G.A., 15:38163
See Santarius, J.F., 15:38155
See Sviatoslavsky, I.N., 15:38234
Woicik, J.C., *See* Tan, Z., 15:37260
Wolf, D., Structure-energy correlation for grain boundaries in F.C.C. metals: I. boundaries on the (111) and (100) planes, 15:37721 (J;US)
See Phillpot, S.R., 15:37321
Wolf, J.S., Oxidation and sulfidation of Type 310S stainless steel at elevated temperatures, 15:37183 (R;US)
Wolf, M.L., *See* Hummel, K.E., 15:38319
Wolfe, C.R., Design and fabrication of high damage threshold turning mirrors for the Nova laser, 15:37244 (R;US)
Laser conditioning of optical thin films, 15:38272 (R;US)
Optical damage in epoxy polymers by millisecond light pulses, 15:37304 (BA;US)
See Kozlowski, M.R., 15:38273
Wolfe, P., The industrial lighting incentive program: Process and impact evaluation, 15:37062 (RA;US)
Wolfer, W.G., dc electrical conductivity of D-T gas, 15:37319 (J;US)
Wolfram, J.H., A summary of microbial influenced corrosion in nuclear power plants, 15:36992 (BA;US)
Wolfsthal, J.B., *See* Dunn, L.A., 15:37160
Wong, C.P.C., Blanket design for the ARIES-I tokamak reactor, 15:38154 (RA;US)
See Cheng, E.T., 15:38171
See Sze, D.K., 15:38153
Wong, J., *See* Lytle, F.W., 15:37221
Wong, J.S., *See* Yen, Yu-Sze, 15:37218
Wong, R.L., Program CICC, flow and heat transfer in cable in conduit conductors (CICC), 15:38174 (RA;US)
Wong, Y.L., *See* Cheng, S.C., 15:36913
Woo, K.C., *See* Kim, D.H., 15:37279
Wood, G., *See* Dennis, B., 15:36727
Woods, C.L., *See* Catford, W.N., 15:37850
Woodward, J.C., *See* Thorstenson, D.C., 15:36771
Woodworth, J.R., Lithium ion beam experiments on PBFA II, 15:38283 (BA;US)
Woosley, S.E., *See* Howard, W.M., 15:37696
Word, G., *See* Atwood, W., 15:38334
Wormser, G., Selected topics from NA14': charm production and new results on D_s decays, 15:37769 (R;FR)
Wright, A.E., *See* Doerner, R.C., 15:36953
See Liu, Y.Y., 15:36961
Wright, E.K., *See* Glowka, D.A., 15:36871
Wright, L.J., *See* Holmes, J.P., 15:38346
Wuosmaa, A.H., Spin alignment and resonance behavior in the $^{24}Mg+^{24}Mg$ system, 15:37864 (J;US)
Wurden, G.A., *See* Weber, P.G., 15:38063
Wuyts, B., *See* Bjornholm, T., 15:37276

X

Xia, H., Generalized Langevin equation for plasma turbulence, 15:38058 (BA;US)
Xiao, H., *See* Montalvo, E., 15:38011
Xie, Y.J., *See* Huang, Z.Q., 15:37541
Xin-Zhong, Liang, *See* Gutowski, W.J., 15:37565
Xu, M., *See* Shi, D., 15:37250, 15:37267
Xu, Y., *See* Huber, J.G., 15:37264
See Tsuo, Y.S., 15:36841

Y

Yager, R.W., *See* Kozub, T.A., 15:38209
Yahiro, M., Polarized ^{3}He beam with intermediate energies: sup 3He elastic scattering and (sup 3He, sup 2He) reaction, 15:37900 (RA;JP;In Japanese)
Yamada, K., *See* Sternlieb, B.J., 15:37268
Yamagishi, H., *See* Coriano, C., 15:37820
Yamaguchi, Akira, *See* Kawai, Takeshi, 15:37928
Yamaguchi, Yoshio, Origin of CP violation, 15:37807 (RA;JP;In Japanese)
Yamamoto, M., *See* Horie, T., 15:38228
See Horiike, H., 15:38164
Yamamoto, Y., *See* Yoshikawa, K., 15:38224
Yamamoto, Yasushi, Effects of beam perveance to the performance characteristics of the electrically electron-suppressed beam direct converter with secondary electron suppressor grids, 15:38162 (RA;US)
Yamanaka, Kaoru, New non-axisymmetric eigenmodes associated with an edge plasma layer, 15:38038 (R;JP)
Yang, C.M., *See* Atwater, H.A., 15:37969
Yang, D.J., *See* Winkleman, B.C., 15:37040
Yang, K.N., *See* Allen, J.W., 15:37271
Yao, R.L., *See* Striffler, C.D., 15:38280
Yarber, J.L., *See* Schwenterly, S.W., 15:38140
Yasuda, Yusuke, Frequency response method for the study of kinetics of a heterogeneous catalytic reaction of gases, 15:37216 (J;US)
Yasue, M., Two-nucleon correlations in ^{14}C through (p,t) reaction, 15:37852 (RA;JP;In Japanese)
Yates, J.T. Jr., *See* Siddiqui, H.R., 15:37366
Yates, S.W., *See* Becker, J.A., 15:37882
Ye, T.Q., *See* Graener, H., 15:37356
Yeager, E.B., *See* Selman, J.R., 15:37044
Yee, L.Y., *See* Sharafat, S., 15:38216
Yellowhorse, L., *See* Pacheco, J., 15:36856
Yen, Yu-Sze, Infrared reflectance properties of surface thin films, 15:37218 (J;US)
Yevstratov, V.V, *See* Kuperin, Yu.A., 15:37993
Yin Zhiwei, *See* Geng Yongjian, 15:37664
Yokoya, Kaoru, Beam phenomena at the interaction point, 15:37452 (RA;US)
Electron energy spectrum and maximum disruption angle under multi-photon bremsstrahlung, 15:37461 (BA;US)
Prospect of electron polarization at TRISTAN, 15:37508 (RA;JP)
Yoshida, H., *See* Anderson, J., 15:38105
Yoshida, K., *See* Koizumi, K., 15:38178
See Nishi, M.F., 15:38098
Yoshikawa, K., Study of an advanced D-T tokamak fusion reactor with compact fusion advanced rankine (CFAR) cycle, 15:38224 (RA;US)
Yoshikawa, Kiyoshi, *See* Yamamoto, Yasushi, 15:38162
Yoshiki, Hajime, *See* Kawai, Takeshi, 15:37928
Yosoi, M., High resolution magnetic spectrograph 'Grand Raiden', 15:37532 (RA;JP;In Japanese)
Young, B.A., Observation of ballistic phonons in silicon crystals induced by α particles, 15:37317 (J;US)
Young, F.C., Vacuum ultraviolet radiation from neon implosions, 15:38301 (BA;US)
Young, G.R., Experimental results concerning global observables from the CERN SPS heavy ion program, 15:37752 (R;US)
Experimental results from studies on nucleus-nucleus collisions at high energy, 15:37826 (R;US)
See Plasil, F., 15:37881
Young, L., *See* Schrage, D., 15:37431
Young, P.E., *See* Mizuno, K., 15:38057
Youngblood, R., *See* Oliveira, L.F., 15:37385
Yourd, D.A., *See* DiGioia, A.M. Jr., 15:36998
Yourstone, E., *See* Schweitzer, M., 15:37038
Yu, K.M., *See* Chan, K.T., 15:37311
Yu, S.S., *See* Hopkins, D.B., 15:37483
Yudelev, M., *See* Jones, D.T.L., 15:37529

Z

Zacharia, T., *See* David, S.A., 15:36691
Zagar, D.M., *See* Rochau, G.E., 15:38263
Zappellini, G., *See* Boschi, A., 15:38169
Zardecki, A., *See* Armstrong, R.L., 15:37416
Zatz, I., *See* Brooks, A.W., 15:38218
Zeigler, J.M., *See* Kubiak, G.D., 15:37960
Zelenskii, A.N., *See* Levy, C.D.P., 15:37500
Zelinski, R.W., Transportation of nuclear materials: A concern for local governments, 15:36808 (BA;US)
Zemach, C., *See* Besnard, D.C., 15:37739
Zerdoum, R., Study and realization by liquid phase epitaxy of $Ga_{1-y}Al_yAs$ photocells, 15:36831 (R;FR;In French)
Zettl, A., *See* Crommie, M.F., 15:37272
Zhang Xianye, *See* Zhou Zhihong, 15:37368
Zhang, C.Y., *See* Kuehl, H.H., 15:38054
Zhang, D.J., *See* Kim, Kyekyoon, 15:38212
Zhang, H., Two- and three-dimensional magnetic order of the rare-earth ions in $RBa_2Cu_4O_8$, 15:37277 (J;US)
Zhang, J.P., *See* Li, D.J., 15:37163
Zhang, Y., Probing the Coulomb gap in insulating *n*-type CdSe, 15:37316 (J;US)
Zhao, X., *See* Chong, S.L., 15:36756
Zhao, Zong-ci, *See* Schlesinger, M.E., 15:37566
Zheng Hualing, The irradiation effects on extraction properties and physical data of 30% TRPO-kerosene, 15:37367 (R;CN;In Chinese)
Zhenping LI, QCD mixing effects in a gauge invariant quark model for photo- and electroproduction of baryon resonances, 15:37790 (R;GB)
Zhou Shunli, *See* Zheng Hualing, 15:37367
Zhou Zhihong, The photochemical behaviour of plutonium (IV), 15:37368 (R;CN;In Chinese)
Zhu, W., *See* Li, G., 15:38302
Zhu, X.D., Multipolar contributions to optical second-harmonic generation in isotropic fluids, 15:38002 (J;US)
Ziebarth, R., *See* Vassiliou, J.K., 15:37166
Zielinski, J.J., Magnetic field effects in electrostatic analyzers used for heavy ion beam probe measurements, 15:38081 (BA;US)
Ziemniak, S.E., Copper(II) oxide solubility behavior in aqueous sodium phosphate solutions at elevated temperatures, 15:37236 (R;US)
Zimmerman, G.T., *See* Miller, S.L., 15:37424
Zisman, M.S., Estimate of allowable beam current at 12 GeV, 15:37505 (R;US)
Influence of collective effects on the performance of high-luminosity colliders, 15:37453 (R;US)
Ziton, R., *See* Campagne, J.E., 15:37775
Zouros, T.J.M., *See* Lee, D.H., 15:37728
Zurmuehle, R.W., *See* Wuosmaa, A.H., 15:37864
Zutavern, F.J., Recovery of high field GaAs photoconductive semiconductor switches, 15:37410 (R;US)

Subject Index

This index is arranged by subject descriptors selected from those assigned to each citation in this publication. Subject descriptors are selected from a controlled thesaurus of terms, *EDB Subject Thesaurus* (DOE/OSTI-7000). In order to enhance indexing, subject descriptor entries generally consist of a pair of descriptors: a main term and a qualifier term. Each entry includes the full title (which may be followed by supplementary descriptive information in parentheses) and the citation number. Additional information given in parentheses indicates the document type (an abbreviation such as B for book), the country of publication (such as DE for Federal Republic of Germany), and the language if non-English.

See references guide users from synonymous terms to the descriptors selected for the concept. *See also* references indicate subject concepts that are more specific than a particular descriptor. To gain complete subject coverage, all such terms should be reviewed.

A

A 285 STEEL
See STEEL-ASTM-A285
A CODES
Alternative Motor Fuel Use Model: Model theory and design and user's guide, 15:37159 (R;US)
Technical description of AVENU: A comprehensive computer software system for wind farm design, 15:36884 (BA;US)
A RESONANCES
See MESONS
A2H-1320 RESONANCES
See MESONS
A2L-1280 RESONANCES
See MESONS
ABANDONED SITES
Environmental compliance assessment findings for Weldon Spring Site Remedial Action Program, 15:36805 (R;US)
ABNORMALITIES (CHROMOSOMAL)
See CHROMOSOMAL ABERRATIONS
ABSORBERS (SOLAR)
See SOLAR ABSORBERS
ABSORPTION (ROOT)
See ROOT ABSORPTION
ACCELERATOR FACILITIES
See also STANFORD LINEAR COLLIDER
TARGET CHAMBERS
STL [Simulation Technology Laboratory] Global Control System, technical reference, 15:37499 (R;US)
ACCELERATORS
See also BEAT WAVE ACCELERATORS
COLLECTIVE ACCELERATORS
HEAVY ION ACCELERATORS
LINEAR ACCELERATORS
MESON FACTORIES
PARTICLE BEAM FUSION ACCELERATOR
RAILGUN ACCELERATORS
A flight-qualified RFQ for the BEAR project, 15:37431 (RA;US)
An RF-driven lasertron, 15:37473 (RA;US)
Consideration on feasibilities of double polarization experiments with polarized electron (or photon) beam and polarized target, 15:37486 (RA;JP)
Current and future uses of accelerators in particle astrophysics, 15:37698 (J;US)
Electron accelerators and nuclear physics, 15:37426 (R;FR)
High energy (1-2 MeV) beams for magnetic fusion - tokamak plasma heating and current drive, 15:37432 (RA;US)
Physics Division progress report for period ending September 30, 1989, 15:37836 (R;US)
Proceedings of the CAP [Center for Accelerator Physics] meetings, October 1989–April 1990, 15:37430 (R;US)
Superconducting accelerating structures for high-current ion beams, 15:37466 (RA;US)
Temporal characterization of the 19-MV, 700-kA HERMES III electron beam, 15:37445 (R;US)
Transition crossing with the space charge: The Johnsen and Umstaetter effects, 15:37456 (R;US)
ACCESS DENIAL SYSTEMS
See ENTRY CONTROL SYSTEMS
ACCIDENTAL INTAKE
See ACCIDENTS
ACCIDENTAL IRRADIATION
See RADIATION ACCIDENTS
ACCIDENTS
See also INDUSTRIAL ACCIDENTS
RADIATION ACCIDENTS
REACTOR ACCIDENTS
Evaluating protective actions for chemical agent emergencies, 15:37560 (R;US)
Transportation accidents/incidents involving radioactive materials, (1971–1989), 15:36807 (R;US)
[Radiation protection]: Foreign trip report, April 8–16, 1988, 15:37670 (R;US)
ACETYLENES
See ALKYNES
ACID RAIN
Conceptualization of TREE: A model of the effects of acid precipitation and air pollutants on the growth of trees: Progress report, 15:37586 (R;US)
Sixth annual Gatlinburg acid rain conference: Proceedings, 15:37679 (R;US)
The greenhouse effect and acid rain: A tutorial, 15:37580 (R;US)
ACIDIFICATION
Sulfur cycling and fluxes in temperate dimictic lakes, 15:37613 (R;US)
ACPR REACTOR
Annular core research reactor high flux neutron radiography facility, 15:36949 (R;US)
ACRR REACTOR
See ACPR REACTOR
ADENOSINE TRIPHOSPHATE
See ATP
ADMINISTRATION
See MANAGEMENT
ADU
See AMMONIUM URANATES
AEROSOLS
See also RADIOACTIVE AEROSOLS
Propagation of high energy laser beams through metallic aerosols, 15:37416 (J;US)
AIR
Annual radiological environmental monitoring report, Watts Bar Nuclear Plant, 1989, 15:37581 (R;US)
Annual radiological environmental operating report, Browns Ferry Nuclear Plant, 1989, 15:37582 (R;US)
Annual radiological environmental operating report, Sequoyah Nuclear Plant, 1989, 15:37583 (R;US)
Onsite environmental report for the Nevada Test Site, January 1988–December 1988, 15:37567 (R;US)
Perturbation growth by thermal blooming in turbulence, 15:37742 (J;US)

AIR CONDITIONING
Impact of heating and air conditioning system operation and leakage on ventilation and intercompartment transport: Studies in unoccupied and occupied Tennessee Valley homes, 15:37137 (J;US)

AIR POLLUTION
Dose-response-relationships for phytotoxic air pollutants, where no air quality standards have been established. Criteria for decision-making in special cases (TA Luft, 2.2.1.3), 15:37680 (R;DE;In German)
Modelling of the transport of air pollution in orographic regions like Northeast Bavaria, 15:37584 (R;DE;In German)
Progress in the prevention and control of air pollution in 1988: Report to congress. Annual report, 15:37572 (R;US)
Sixth annual Gatlinburg acid rain conference: Proceedings, 15:37679 (R;US)
The effects of urban air pollution on solar radiation, 15:36829 (R;US)

AIR QUALITY
A rapid response air quality analysis system for use in projects having stringent quality assurance requirements, 15:37592 (J;US)

AIR-FUEL RATIO
See FUEL-AIR RATIO

AIRBORNE PARTICLES
See PARTICULATES

AIRBORNE PARTICULATES
See PARTICULATES

AIRCRAFT ACCIDENTS
See ACCIDENTS

ALCATOR DEVICE
Calculation of neutron and γ production and transport for the Alcator C-Mod experiment, 15:38119 (RA;US)
Superstructure for a super tokamak: Alcator C-MOD, 15:38219 (RA;US)
The Alcator C-MOD power system, 15:38190 (RA;US)

ALCOHOLS
See also ETHANOL
METHANOL
Search for Urbach tails in the optical absorption spectra of solvated electrons in alcohols and water, 15:37358 (J;US)

ALFVEN WAVES
Filamentation instability of MHD waves in solar wind plasma, 15:38055 (BA;US)
New non-axisymmetric eigenmodes associated with an edge plasma layer, 15:38038 (R;JP)

ALGEBRAIC FIELD THEORY
Duality and modular invariance in rational conformal field theories, 15:37811 (R;DK)

ALKANES
See also CYCLOALKANES
DECANE
METHANE
PARAFFIN
The role of olefins in the autoignition chemistry of paraffinic hydrocarbons, 15:36740 (BA;US)

ALKENES
The role of olefins in the autoignition chemistry of paraffinic hydrocarbons, 15:36740 (BA;US)
Transition metal mediated transformations of small molecules: Annual progress report, December 1, 1989–November 30, 1990, 15:37340 (R;US)
Vibrational population lifetimes of polyalkenes in liquid solution, 15:37356 (J;US)

ALKINES
See ALKYNES

ALKYLATES
See ALCOHOLS

ALKYNES
The reactivity of the thioalkyne, MeSC≡CSMe, with ruthenium and tungsten complexes, 15:37351 (R;US)

ALLOY-1915
See ALUMINIUM BASE ALLOYS

ALLOY-214X
See ALUMINIUM BASE ALLOYS

ALLOY-50KH4N6G12F2V
See CHROMIUM ALLOYS

ALLOY-60T
See TITANIUM BASE ALLOYS

ALLOY-GE
See COPPER ALLOYS

ALLOY-MA-956
See IRON BASE ALLOYS

ALLOY-NI73CR15FE7TI3
Failure of Inconel X-750 bolts of internals of the CHOOZ-A nuclear power plant, 15:36910 (R;FR)

ALLOY-VTZ-1
See TITANIUM BASE ALLOYS

ALLOYS
See also ALUMINIUM ALLOYS
BORON ALLOYS
CHROMIUM ALLOYS
COBALT ALLOYS
COPPER ALLOYS
INTERMETALLIC COMPOUNDS
IRON ALLOYS
MOLYBDENUM ALLOYS
NICKEL ALLOYS
NIOBIUM ALLOYS
RARE EARTH ALLOYS
THALLIUM ALLOYS
TIN ALLOYS
TITANIUM ALLOYS
TRANSITION ELEMENT ALLOYS
TUNGSTEN ALLOYS
VANADIUM ALLOYS
ZIRCONIUM ALLOYS
An initial comparison of pitting resistance of alloys for potential geothermal applications, 15:36869 (R;US)
Metals and Ceramics Division progress report for period ending September 30, 1989, 15:37192 (R;US)
The use of high power lasers in surface modifications, 15:37201 (BA;US)
[International conference on free and moving boundary problems]: Foreign trip report, October 9, 1988–October 23, 1988, 15:38327 (R;US)

ALPHA PARTICLES
Experimental nuclear physics: Excitation of giant multipole resonances with 120 and 140 MeV alpha particles, 15:37832 (RA;ZA)
Methods of calculating the Barkas-effect correction to Bethe–Bloch stopping power, 15:37935 (J;US)

ALPHA-BEARING WASTES
Initial tests on in situ vitrification using electrode feeding techniques, 15:36787 (R;US)
Preliminary identification of scenarios that may affect the escape and transport of radionuclides from the Waste Isolation Pilot Plant, southeastern New Mexico, 15:36789 (R;US)
Sandia Sorption Data Management System, Version 2 (SSDMS II): User's manual, 15:36788 (R;US)

ALUMINATES
Structural and spectroscopic investigations of $LaFeAl_{11}O_{19}$ compounds, 15:37165 (J;US)

ALUMINIA
See ALUMINIUM OXIDES

ALUMINIUM
Development of surface treatments and alloy modifications for corrosion-resistant oxide scales, 15:36692 (R;US)
Methods of calculating the Barkas-effect correction to Bethe–Bloch stopping power, 15:37935 (J;US)
Molecular dynamics simulations of grain-boundary diffusion for varying tilt angle geometries, 15:37196 (R;US)
New selective anion-exchange resins for nitrate removal from contaminated drinking water and studies on analytical anion-exchange chromatography, 15:37616 (R;US)
Regular and chaotic motion of classical electrons in the wake potential of fast ions in solids, 15:37933 (J;US)

Vacuum outgassing from diffuse-absorptive baffle materials, 15:37181 (R;US)

ALUMINIUM 27 TARGET
Prequilibrium (*p,n*) reaction as a probe for the effective nucleon-nucleon interaction in multistep direct processes, 15:37863 (J;US)

ALUMINIUM ALLOYS
See also ALUMINIUM BASE ALLOYS
A kinetic criterion for quasi-brittle fracture, 15:37208 (J;US)
Compendium of material test results on HY-130 and Ti-3Al-2V metals in support of United States Navy programs: Interim report, 15:37197 (R;US)
Crystal growth and deformation behavior of TiAl aluminides, 15:37193 (R;US)
Deposition and adhesion of PECVD boron coatings on Ti-6Al-4V substrates, 15:37202 (BA;US)
Development of surface treatments and alloy modifications for corrosion-resistant oxide scales, 15:36692 (R;US)
Moisture-induced embrittlement of Fe_3Al, 15:36690 (R;US)
Weldability of iron aluminides, 15:36691 (R;US)

ALUMINIUM ARSENIDE SOLAR CELLS
Study and realization by liquid phase epitaxy of $Ga_{1-y}Al_yAs$ photocells, 15:36831 (R;FR;In French)

ALUMINIUM ARSENIDES
Growth studies of pseudomorphic GaAs/InGaAs/AlGaAs modulation-doped field-effect transistor structures, 15:37311 (J;US)

ALUMINIUM BASE ALLOYS
Formation of cubic Ll_2 phases from Al_3Ti and Al_3Zr by transition metal substitutions for Al, 15:37180 (R;US)

ALUMINIUM OXIDES
Activation evaluation of fusion solid breeder materials, 15:38171 (RA;US)
Enhanced ionic conductivity in composite electrolytes, 15:37307 (BA;US)
Evaluation of alumina dispersion strengthened (ODS) copper for possible use in the central solenoid and TF coils for the compact ignition tokamak (CIT), 15:38095 (RA;US)
GlidCop dispersion strengthened copper: Potential applications in fusion power generators, 15:38103 (RA;US)
Growth of Al oxide layers on GaAs (100) by reaction with condensed molecular oxygen, 15:37322 (J;US)
Mechanism of hydrodenitrogenation: Part 1, Preparation and characterization of acidic supports, 15:36696 (R;US)

ALUMINUM
See ALUMINIUM

AMIDES
See also UREA
Mechanism and applicability of hydrolysis of peptides and proteins utilizing Pt(II) complexes, 15:37521 (R;US)

AMINES
See also NITROSAMINES
POLYCYCLIC AROMATIC AMINES
RHODAMINES
A time-resolved Raman study of the reaction of OH radicals with p-phenylenediamine, 15:37370 (J;US)
An investigation of amine-induced stress corrosion cracking of steels in natural gas treatment plants: Final report, 15:36744 (R;US)

AMINO ACIDS
See also CYSTEINE
EDTA
Mechanism and applicability of hydrolysis of peptides and proteins utilizing Pt(II) complexes, 15:37521 (R;US)

AMINO ALCOHOLS
See ALCOHOLS
AMINES

AMINO SUGARS
See AMINES

AMINOGLYCIDES
See AMINES

AMMONIA
Dissociation dynamics and multiphoton ionization mechanism of ammonia clusters, 15:37357 (J;US)
Solubility of ammonia in pure aqueous and multicomponent solutions, 15:36825 (J;US)

AMMONIUM DIURANATE
See AMMONIUM URANATES

AMMONIUM URANATES
Biological characterization of radiation exposure and dose estimates for inhaled uranium milling effluents: Final report, 15:36803 (R;US)

AMPLIFIERS
See also MICROWAVE AMPLIFIERS
Design considerations of high peak power gyroklystrons for linear colliders, 15:37481 (RA;US)
First tests of the Varian EIMAC X2242 at 110 and 130 MHz in the JT-60 ICRH system, 15:38252 (RA;US)
Gain and noise characteristics of a Brillouin amplifier and their dependence on the spatial structure of the pump beam, 15:37542 (J;US)

ANNULAR CORE PULSE REACTOR
See ACPR REACTOR

ANNULAR CORE RESEARCH REACTOR
See ACPR REACTOR

ANTENNAS
An assessment of the lifetime of Faraday shield elements, 15:38129 (RA;US)
Thermal and stress analysis of the Faraday shield for the ORNL/TFTR RF antenna, 15:38237 (RA;US)

ANTIFERROMAGNETIC MATERIALS
Anyons in the *XY* model induced by charged holes, 15:37973 (J;US)
Fermions and solitons in the O(3) nonlinear σ model in 2+1 space-time dimensions, 15:37983 (J;US)

ANTIPROTON REACTIONS
Neutral strange particle production in antiproton-nucleus annihilation at low energies, 15:37895 (R;SU)

APPARATUS
See EQUIPMENT

APPLIANCES
Enactment of federal energy efficiency standards for residential appliances, 15:37131 (BA;US)

APPLICATORS (RADIOTHERAPY)
See RADIATION SOURCES

AQUATIC ECOSYSTEMS
See also WETLANDS
Review of the chronic exposure pathways models in MACCS [MELCOR Accident Consequence Code System] and several other well-known probabilistic risk assessment models, 15:37599 (R;US)

AQUEOUS SOLUTIONS
Computer modeling of the chemistry of aqueous scrubber systems, 15:36900 (R;US)

AQUIFERS
Application of the finite-element program NAMMU for a model of a radioactive waste repository site, 15:36765 (R;DE;In German)

ARCTIC REGIONS
Factors controlling decomposition in arctic tundra and related root mycorrhizal processes: [Progress report], 15:37635 (R;US)

ARDENNES REACTOR
Failure of Inconel X-750 bolts of internals of the CHOOZ-A nuclear power plant, 15:36910 (R;FR)

ARGON
Vibrational relaxation of highly excited SiF_4 and C_6F_5H by Ar, 15:37352 (J;US)

ARGON 40 REACTIONS
Heavy actinide production from the interactions of ^{40}Ar with ^{248}Cm and a comparison with the ^{44}Ca-^{248}Cm system, 15:37887 (J;US)

AROMATIC COMPOUNDS
See AROMATICS

AROMATICS
See also BIPHENYL
PHENOLS
Ion dip spectroscopy of van der Waals clusters, 15:37337 (J;US)

ARRAY PROCESSORS
A scalable coherent cache system with fuzzy directory state, 15:38337 (R;US)
A scalable coherent cache system with incomplete directory state, 15:38339 (R;US)
[Conference on vector and parallel computing]: Foreign trip report, May 31, 1988–June 14, 1988, 15:38322 (R;US)
ASBESTOS
Environmental compliance assessment findings for Weldon Spring Site Remedial Action Program, 15:36805 (R;US)
ASHES
Experimental and theoretical investigation of the formation and growth of ash agglomerates: Final report, 15:36693 (R;US)
ATMOSPHERIC CHEMISTRY
Ab initio SCF studies of the electronic structures of halogen nitrates. 2. FNO_x (x = 1, 2, 3), 15:37593 (J;US)
ATMOSPHERIC CIRCULATION
Air-pollution tracer studies in the lower atmosphere. May 1985-March 1990 (A Bibliography from the NTIS data base). Report for May 1985-March 1990, 15:37578 (R;US)
MAB-project 6 'Research for the ecological system Berchtesgaden': Climatological measurements at the Alpine National Park, wind systems and inversions. Disciplinary report FB 07 climatology, 15:37585 (R;DE;In German)
ATOMIC CLOUDS
See RADIOACTIVE CLOUDS
ATOMIC ENERGY
See NUCLEAR ENERGY
ATOMIC PHYSICS
Atomic physics: Beam foil spectroscopy, 15:37713 (RA;ZA)
Physics Division progress report for period ending September 30, 1989, 15:37836 (R;US)
ATOMS
Excitation of atoms passing through a TEM_{00} Gaussian laser beam at relativistic velocities, 15:37415 (J;US)
Experimental design of spectroscopic measurements of microwave electric field in MTX tokamak plasma, 15:38079 (BA;US)
Prospect of multiphoton induced inner shell excitations for x-ray laser pumping, 15:38296 (BA;US)
Radiofrequency ionization of helium with turbulent flow-measurements versus theory, 15:38289 (BA;US)
Test of the linearity of quantum mechanics in an atomic system with a hydrogen maser, 15:37722 (J;US)
ATP
Incision of damaged versus nondamaged DNA by the Escherichia coli UvrABC proteins, 15:37639 (J;US)
AUSTENITE
Stability of laser-induced retained austenite in ductile iron, 15:37200 (BA;US)
AUSTENITIC STEELS
Effects of deformation (strain) and heat treatment on grain boundary sensitization and precipitation in austenitic stainless steels, 15:37203 (J;US)
AUTOMOBILE EFFICIENCY STANDARDS
See AUTOMOBILES
STANDARDS
AUTOMOBILES
Light-duty vehicle MPG [miles per gallon] and market shares report, Model year 1989, 15:37139 (R;US)
AUTOMOTIVE FUELS
Alternative Motor Fuel Use Model: Model theory and design and user's guide, 15:37159 (R;US)
Alternative transportation fuels: A tax and energy perspective, 15:36824 (BA;US)
AUTORADIOGRAPHS
See IMAGES

B

B MESONS
B meson decay in LUND 6.3, 15:37762 (RA;JP)
Exclusive and inclusive decays of *B* mesons into D_s mesons, 15:37781 (J;US)
Physics of the B system, 15:37805 (RA;JP)
BACKGROUND RADIATION
NRC TLD [thermoluminescent dosimeter] Direct Radiation Monitoring Network: Progress report, January–March 1990: Volume 10, No. 1, 15:36973 (R;US)
BACTERIA
See also ESCHERICHIA COLI
METHANOGENIC BACTERIA
Variable rRNA gene copies in extreme halobacteria, 15:37638 (J;US)
BAFFLES
Vacuum outgassing from diffuse-absorptive baffle materials, 15:37181 (R;US)
BALL LIGHTNING
Ball lightning as a route to fusion energy, 15:38232 (RA;US)
BALLISTIC MISSILE DEFENSE
Department of Energy Strategic Defense Initiative programs: Potential programmatic and facility impacts due to a prospective defense and space treaty, 15:37554 (R;US)
Guidance and targeting for the strategic target system, 15:37557 (R;US)
Multimegawatt space power reactors, 15:36925 (R;US)
BANKS
See COMMERCIAL BUILDINGS
BARIUM OXIDES
Absorption Spectra
Determination of the valence of Pr, Gd, and Ho in $YBa_2Cu_3O_7$ by x-ray absorption spectroscopy, 15:37221 (J;US)
Atom Transport
Monte Carlo study of tracer and chemical diffusion of oxygen in $YBa_2Cu_3O_{6+2c}$, 15:37273 (J;US)
Bromination
Metallization and superconducting properties of $YBa_2Cu_3O_{6.2}Br_y$, 15:37275 (J;US)
Critical Current
Large, orientation-dependent enhancements of critical currents in $Y_1Ba_2Cu_3O_{7-x}$ epitaxial thin films: Evidence for intrinsic flux pinning?, 15:37228 (R;US)
Neutron-induced microwave loss in ceramic $YBa_2Cu_3O_{7-\delta}$, 15:37259 (J;US)
Rapid thermal processing of $YBa_2Cu_3O_7$ spun wires, 15:37261 (J;US)
Transport critical current density and microstructure in extruded $YBa_2Cu_3O_{7-x}$ wires processed by zone melting, 15:37250 (J;US)
Crystal-Phase Transformations
Numerical investigation of a model for oxygen ordering in $YBa_2Cu_3O_{6+x}$, 15:37265 (J;US)
Deposition
Theoretical model for deposition of superconducting thin films using pulsed laser evaporation technique, 15:37251 (J;US)
Dielectric Properties
Temperature and frequency dependences of the dielectric properties of $YBa_2Cu_3O_{6+x}$ ($x \approx 0$), 15:37270 (J;US)
Growth
Y-Ba-Cu-O thin films grown on rigid and flexible polycrystalline yttria-stabilized zirconia by pulsed laser ablation, 15:37249 (J;US)
Heat Treatments
Rapid thermal processing of $YBa_2Cu_3O_7$ spun wires, 15:37261 (J;US)
Some observations of the effects of high pressures and temperatures on the stability of $YBa_2Cu_3O_{7-x}$, 15:37355 (J;US)
Magnetic Flux
Increase in the flux-pinning energy of $YBa_2Cu_3O_{7-\delta}$ by shock compaction, 15:37255 (J;US)
Magnetic Properties
Two- and three-dimensional magnetic order of the rare-earth ions in $RBa_2Cu_4O_8$, 15:37277 (J;US)
Mechanical Properties
Increase in the flux-pinning energy of $YBa_2Cu_3O_{7-\delta}$ by shock compaction, 15:37255 (J;US)

Microstructure
Transport critical current density and microstructure in extruded $YBa_2Cu_3O_{7-x}$ wires processed by zone melting, 15:37250 (J;US)
Phase Diagrams
Phase diagram and low-temperature behavior of oxygen ordering in $YBa_2Cu_3O_z$ using *ab initio* interactions, 15:37263 (J;US)
Physical Radiation Effects
Neutron-induced microwave loss in ceramic $YBa_2Cu_3O_{7-\delta}$, 15:37259 (J;US)
Strongly enhanced flux pinning by high-energy proton irradiation of a $Tl_2Ca_2Ba_2Cu_3O_y$ single crystal, 15:37258 (J;US)
Raman Spectra
Raman-active phonons of a twin-free $YBa_2Cu_3O_7$ crystal: A complete polarization analysis, 15:37266 (J;US)
Reflectivity
Anomalous pressure dependence of optical reflectivity in the superconductor $Ba_{0.6}K_{0.4}BiO_3$, 15:37278 (J;US)
Spin-Lattice Relaxation
Spin and charge excitations in $YBa_2Cu_3O_7$: Constraints from spin-relaxation rates in the normal state, 15:37274 (J;US)
Superconductivity
Filled-band model leading to supercurrents in La-Ba-Cu-O, 15:37269 (J;US)
Metallization and superconducting properties of $YBa_2Cu_3O_{6.2}Br_y$, 15:37275 (J;US)
Superconducting thin-film multiturn coils of $YBa_2Cu_3O_{7-x}$, 15:37420 (J;US)
Superconductivity and oxygen ordering in $(Ca,Ba,La)Cu_3O_{7-\delta}$, 15:37276 (J;US)
Transition Temperature
Rapid thermal processing of $YBa_2Cu_3O_7$ spun wires, 15:37261 (J;US)
Superconductivity under high pressure of $YBa_2(Cu_{1-xMx})_3O_{7-\delta}$ (*M*=Fe, Co, Al, Cr, Ni, and Zn), 15:37264 (J;US)

BARYON NUMBER 2 RESONANCES
See DIBARYONS

BARYON RESONANCES
See BARYONS

BARYON SPECTROSCOPY
QCD mixing effects in a gauge invariant quark model for photo- and electroproduction of baryon resonances, 15:37790 (R;GB)

BARYONS
See also DIBARYONS
NUCLEONS
Late-time dissipation of primordial baryon-number fluctuations and nucleosynthesis, 15:37804 (J;US)

BATTERIES (ELECTRIC)
See ELECTRIC BATTERIES

BEAM ANALYZERS
See also ELECTROSTATIC ANALYZERS
Design studies of the 2 mev heavy ion beam probe for text upgrade, 15:38073 (BA;US)

BEAM CURRENTS
Beam current regulation of DIII-D neutral beam long pulse ion sources, 15:38142 (RA;US)

BEAM DYNAMICS
See also BEAM-BEAM INTERACTIONS
Impedance and wakefields beyond cutoff, 15:37450 (RA;US)

BEAM FOCUSING MAGNETS
Modular magnet current regulator, 15:37468 (RA;US)

BEAM TRANSPORT
The separated-sector cyclotron: beam transport: Operation and development, 15:37493 (RA;ZA)

BEAM-BEAM INTERACTIONS
Beam phenomena at the interaction point, 15:37452 (RA;US)

BEAM-PLASMA SYSTEMS
Flashlamp-pumped dye and excimer laser planarization of thin metal films, 15:37957 (BA;US)

BEAT WAVE ACCELERATORS
Oscillator and system development on the VULCAN glass laser system for the plasma beat-wave program, 15:37444 (R;GB)

BELLOWS
TFTR neutral beam bellows redesign and calorimeter upgrade, 15:38241 (RA;US)

BENTONITE
Diffusion of Am, Pu, U, Np, Cs, I and Tc in compacted sand-bentonite mixture, 15:37603 (R;SE)
Some notes on diffusion of radionuclides through compacted clays, 15:37604 (R;SE)

BENZOPYRENE
Biological (molecular and cellular) markers of toxicity: Semi-annual technical progress report No. 3, October 1, 1989–March 31, 1990, 15:37677 (R;US)

BERKELIUM ISOTOPES
Heavy actinide production from the interactions of ^{40}Ar with ^{248}Cm and a comparison with the ^{44}Ca-^{248}Cm system, 15:37887 (J;US)

BERYLLIUM
Diffuse absorbing beryllium coatings produced by magnetron sputtering, 15:37182 (R;US)
Vacuum outgassing from diffuse-absorptive baffle materials, 15:37181 (R;US)

BERYLLIUM 9
Late-time dissipation of primordial baryon-number fluctuations and nucleosynthesis, 15:37804 (J;US)

BERYLLIUM 9 TARGET
Angular momentum dependent absorption in ^6Li scattering, 15:37853 (J;US)

BERYLLIUM MODERATORS
See BERYLLIUM

BETA BEAMS (ELECTRONS)
See ELECTRON BEAMS

BETA BEAMS (POSITRONS)
See POSITRON BEAMS

BILATERAL AGREEMENTS
Bilateral agreements providing negative security assurances to states party to the Nuclear Non-Proliferation Treaty, 15:37161 (R;US)

BINARY MIXTURES
Weakly nonlinear states as propagating fronts in convecting binary mixtures, 15:37391 (J;US)

BIOGAS
See METHANE

BIOLOGICAL MATERIALS
See also TISSUE EXTRACTS
Accelerator mass spectrometry in the biomedical sciences: Applications in low-exposure biomedical and environmental dosimetry, 15:37653 (R;US)

BIOLOGICAL REACTORS
See BIOREACTORS

BIOLOGICAL SHIELDS
Calculation of neutron and γ production and transport for the Alcator C-Mod experiment, 15:38119 (RA;US)
Radiation shielding for TFTR D-T operation, 15:38125 (RA;US)

BIOMASS
Cellulase: A key enzyme for fermentation feedstocks: Progress report, September 1, 1987–August 31, 1988, 15:37631 (R;US)
Cellulase: A key enzyme for fermentation stocks: Final report, 1987–1989, 15:37632 (R;US)
Cellulase: A key enzyme for fermentation stocks: Progress report, 1989–1990, 15:37633 (R;US)
Pyrolysis-gasification of biomass. Development of a fluidized bed reactor, 15:36822 (R;FR;In French)

BIOREACTORS
Scale-up and performance of an immobilized cell reactor separator for the production of ethanol from whey lactose, 15:36821 (R;US)

BIOTECHNOLOGY
Center for Bioprocessing Technology and Biotechnology, 15:36700 (R;US)
[Biotechnology and photosynthesis]: Foreign trip report, June 28–July 14, 1988, 15:36833 (R;US)

BIPHENYL
Smectic-layer growth at solid interfaces, 15:37314 (J;US)

BISMUTH 207
Half-lives of ^{44}Ti and ^{207}Bi, 15:37867 (J;US)

BISMUTH OXIDES
Anomalous pressure dependence of optical reflectivity in the superconductor $Ba_{0.6}K_{0.4}BiO_3$, 15:37278 (J;US)
Effect of microstructural changes on thermally activated flux-creep behavior in the Bi-Sr-Ca-Cu-O system, 15:37267 (J;US)
Thermal conductivity of single-crystal Bi-Sr-Ca-Cu-O, 15:37272 (J;US)
In situ processing of textured superconducting thin film of Bi(-Pb)-Ca-Sr-Cu-O by excimer laser ablation, 15:37256 (J;US)

BLACK LIQUIDS
Research on droplet formation for application to kraft black liquors—Final project report: Technical report No. 5, 15:37146 (R;US)

BLADES (TURBINES)
See TURBINE BLADES

BLANKETS (BREEDING)
See BREEDING BLANKETS

BLASTS
See EXPLOSIONS

BLENDING
See MIXING

BLOCKING
See CHANNELING

BOILERS
Reflux pool-boiler as a heat-transport device for Stirling engines: On-sun test program results, 15:36847 (R;US)

BOILING WATER COOLED AND MODERATED REACTOR
See BWR TYPE REACTORS

BONDING
Field experience in using laser acoustic sensing for inspection, 15:37394 (R;US)

BORATES
Non-random mixing and fast ion decoupling in lithium chloroborate superionic glasses: An ion dynamics computer simulation study, 15:37301 (BA;US)
Structural changes in fast ion conducting chloride Doped potassium borate glasses, 15:37303 (BA;US)

BOREHOLES
Development and field testing of the high-temperature borehole televiewer, 15:37536 (R;US)

BORON
Densification studies of refractory materials using Hot Isostatic Pressing (HIP) and tantalum containment, 15:37243 (R;US)
Deposition and adhesion of PECVD boron coatings on Ti-6Al-4V substrates, 15:37202 (BA;US)

BORON 10
Late-time dissipation of primordial baryon-number fluctuations and nucleosynthesis, 15:37804 (J;US)

BORON ALLOYS
Lorentz electron microscopy of iron-rare-earth-boron sintered permanent magnets, 15:37212 (J;US)
Microstructure of melt spun Nd-Fe-Co-B magnets, 15:37209 (J;US)

BORON CARBIDES
TEM investigations of the neutron irradiation behaviour of boron carbides, 15:37234 (R;DE;In German)

BORON NITRIDES
Densification studies of refractory materials using Hot Isostatic Pressing (HIP) and tantalum containment, 15:37243 (R;US)

BOROSILICATE GLASS
The reaction of glass during gamma irradiation in a saturated tuff environment: Part 4, SRL 165, ATM-1c, and ATM-8 glasses at 1E3 R/h and O R/h, 15:36764 (R;US)

BOROSILICATES
See BOROSILICATE GLASS

BOUNDARIES (GRAIN)
See GRAIN BOUNDARIES

BRACKISH WATER ECOSYSTEMS
See AQUATIC ECOSYSTEMS

BRAIN
Power Burst Facility/Boron Neutron Capture Therapy Program for Cancer Treatment: Monthly bulletin, Volume 4, No. 2, 15:37666 (R;US)

BREAKUP REACTIONS
Four nucleon system at intermediate energy, 15:37901 (RA;JP;In Japanese)

BREEDING BLANKETS
Activation evaluation of fusion solid breeder materials, 15:38171 (RA;US)
Blanket design for the ARIES-I tokamak reactor, 15:38154 (RA;US)
Numerical simulation of turbulent gas-particle fluid flow and heat transfer, 15:38120 (RA;US)
Silicon-carbide composite materials for the ARIES-I reactor study, 15:38216 (RA;US)
The breeding blanket interface (BBI) and the tritium systems test assembly (TSTA), 15:38105 (RA;US)
Tritium analysis of a water-cooled solid breeder blanket for ITER, 15:38121 (RA;US)

BREMSSTRAHLUNG (MAGNETIC)
See SYNCHROTRON RADIATION

BROMINE
Metallization and superconducting properties of $YBa_2Cu_3O_{6.2}Br_y$, 15:37275 (J;US)

BROMINE BROMIDES
See BROMINE

BROMINE IONS
The populations of Rydberg states of ions emerging from solid surfaces, 15:37708 (R;AU)

BUBBLES
Heat transfer between stratified liquids with bubbling across the interface, 15:37392 (R;US)

BUCKLING (STRUCTURAL)
See DEFORMATION

BUDKER ACCELERATORS
See PLASMA BETATRONS

BUILDING (MANUFACTURING)
See FABRICATION

BUILDING MATERIALS
See also CEMENTS
Analysis of wallboard containing a phase change material, 15:37116 (R;US)
Atrium building study, 15:37119 (R;US)
Conventional wallboard with latent heat storage for passive solar applications, 15:37117 (R;US)

BUILDINGS
See also COMMERCIAL BUILDINGS
CONTAINMENT BUILDINGS
DOUBLE ENVELOPE BUILDINGS
An approach to the design of energy efficient heated buildings, 15:37129 (R;GB)
Architectural integration: Residential and light commercial buildings, 15:36854 (BA;US)
Atrium building study, 15:37119 (R;US)
Building envelopes, 15:36851 (BA;US)
Chlorofluorocarbon (CFC) technologies review of foamed-board insulation for buildings, 15:37123 (R;US)
Evaluation of advanced glazing technologies, 15:37133 (BA;US)
How to evaluate a building from short-term tests, 15:37132 (BA;US)
Investigation of radiation effects in Hiroshima and Nagasaki using a general Monte Carlo-discrete ordinates coupling scheme, 15:37932 (R;US)
Joint US/Japanese program of full-size building tests for base seismic isolation, 15:36958 (R;US)
Nonresidential buildings, 15:36855 (BA;US)
Site, community, and urban planning, 15:36850 (BA;US)
The Residential Building Characteristics On-Site Inspection: Summary report, 15:37127 (R;US)
Thermal energy distribution in building interiors, 15:36853 (BA;US)
Thermal energy storage in building interiors, 15:36852 (BA;US)

U-values, solar heat gain and thermal performance: Recent studies using the MoWITT, 15:37134 (BA;US)

BUILDINGS (CONTAINMENT)
See CONTAINMENT BUILDINGS

BUNDLES (FUEL ELEMENTS)
See FUEL ELEMENT CLUSTERS

BWR TYPE REACTORS
Closeout of IE Bulletin 84-03: Refueling cavity water seal: Final report, 15:36979 (R;US)
Data summary report for fission product release test VI-3, 15:36944 (R;US)
Environmentally assisted cracking in light water reactors: Semiannual report, October 1988–March 1989: Volume 8, 15:36906 (R;US)
PR-EDB: Power Reactor Embrittlement Data Base, version 1: Program description, 15:36907 (R;US)
Regulatory analysis for the resolution of generic issue C—8, main steam isolation valve leakage and LCS [leakage control system] failure, 15:36905 (R;US)
Technical support for the EPRI [Electric Power Research Institute] debris coolability requirement for advanced light water reactors: Advanced Reactor Severe Accident Program, 15:36904 (R;US)
[Advanced technologies for water-cooled reactors]: Foreign trip report, May 24–June 12, 1988, 15:36985 (R;US)

C

C-1430 RESONANCES
See MESONS

CABLES (ELECTRIC)
See ELECTRIC CABLES

CACTACEAE
See CACTI

CACTI
High-temperature sensitivity and its acclimation for photosynthetic electron reactions of desert succulents, 15:37673 (J;US)

CADMIUM SELENIDES
Probing the Coulomb gap in insulating *n*-type CdSe, 15:37316 (J;US)

CALCIUM OXIDES
Effect of microstructural changes on thermally activated flux-creep behavior in the Bi-Sr-Ca-Cu-O system, 15:37267 (J;US)
Simultaneous NO_x/SO_2 removal by the dry injection of lime-urea hydrate: Final report, 15:36897 (R;US)
Strongly enhanced flux pinning by high-energy proton irradiation of a $Tl_2Ca_2Ba_2Cu_3O_y$ single crystal, 15:37258 (J;US)
Superconductivity and oxygen ordering in $(Ca,Ba,La)Cu_3O_{7-\delta}$, 15:37276 (J;US)
Thermal conductivity of single-crystal Bi-Sr-Ca-Cu-O, 15:37272 (J;US)
In situ processing of textured superconducting thin film of Bi(-Pb)-Ca-Sr-Cu-O by excimer laser ablation, 15:37256 (J;US)

CALCULATIONS (COMPUTER)
See COMPUTER CALCULATIONS

CALIFORNIUM FLUORIDES
Magnetic susceptibility of californium fluorides, 15:37325 (J;US)

CALIFORNIUM ISOTOPES
Heavy actinide production from the interactions of ^{40}Ar with ^{248}Cm and a comparison with the ^{44}Ca-^{248}Cm system, 15:37887 (J;US)

CALORIMETERS
Data acquisition system realization for H1 experiment, 15:37527 (R;FR;In French)
TFTR neutral beam bellows redesign and calorimeter upgrade, 15:38241 (RA;US)

CALORIMETERS (PARTICLE)
See SHOWER COUNTERS

CAM
See COMPUTER-AIDED MANUFACTURING

CAMAC SYSTEM
TFTR CAMAC power supplies reliability, 15:38109 (RA;US)
Test on fast data transfer between a VME-bus system and a CAMAC system, 15:38030 (R;JP;In Japanese)

CANCER
See NEOPLASMS

CANONICAL QUANTUM FIELD THEORY
See LAGRANGIAN FIELD THEORY

CARBAMIDE
See UREA

CARBINOL
See METHANOL

CARBON
See also DIAMONDS
GRAPHITE
Impurity release disruption effects, and thermomechanical stress analysis of the first wall system for the IGNITEX experiment, 15:38130 (RA;US)
Metal/graphite - composites in fusion engineering, 15:38134 (RA;US)
Time resolved plasma characterization in a long conduction time planar plasma opening switch, 15:38085 (BA;US)
Total dose radiation hardness of diamond-based silicon-on-insulator structures, 15:37315 (J;US)
Wear mechanisms of amorphous carbon and zirconia coatings on rigid disk magnetic recording media, 15:37241 (R;US)

CARBON 11
$^{12}C(^{28}Si,X)^{11}C$ cross section at 13.4 GeV nucleon, 15:37861 (J;US)

CARBON 12
Angular momentum dependent absorption in ^{6}Li scattering, 15:37853 (J;US)

CARBON 12 TARGET
$^{12}C(^{28}Si,X)^{11}C$ cross section at 13.4 GeV nucleon, 15:37861 (J;US)
$^{12}C(n,\gamma_0)^{13}C$ cross section in the 8–11 MeV region, 15:37859 (J;US)
Angular momentum dependent absorption in ^{6}Li scattering, 15:37853 (J;US)
Negative pion-nucleus elastic scattering at 30 and 50 MeV, 15:37860 (J;US)

CARBON 14
Sampling and monitoring of carbon-14 in gaseous effluents from nuclear facilities: Literature survey, 15:36793 (R;FI)

CARBON 14 TARGET
Analysis of pion scattering to stretched states in ^{60}Ni and other nuclei using Woods-Saxon wave functions, 15:37854 (J;US)

CARBON CYCLE
A plan for intermodel comparison of atmospheric CO_2 projections with uncertainty analysis, 15:37571 (R;US)

CARBON DIOXIDE
A plan for intermodel comparison of atmospheric CO_2 projections with uncertainty analysis, 15:37571 (R;US)
Assessing the potential environmental impacts of proposed rules affecting future electric power generation in the United States, 15:36901 (R;US)
Cloud albedo, greenhouse effects, atmospheric chemistry, and climate change, 15:37590 (J;US)
Herbivore responses to plants grown in enriched carbon dioxide atmospheres: Progress report, 15:37658 (R;US)
Report of a workshop on using remote sensing to estimate land use change, 15:37600 (R;US)
Research on CO_2-induced climate change: Final report, 15:37566 (R;US)
Sixth annual Gatlinburg acid rain conference: Proceedings, 15:37679 (R;US)
The greenhouse effect and acid rain: A tutorial, 15:37580 (R;US)
The potential impact of conservation and alternative energy sources on carbon dioxide emissions, 15:37017 (R;US)

CARBON IONS
Binary-encounter electrons observed at 0° in collisions of 1–2-MeV/amu H^+, C^{6+}, N^{7+}, O^{8+}, and F^{9+} ions with H_2 and He targets, 15:37728 (J;US)

CARBON MONOXIDE
Transition metal mediated transformations of small molecules: Annual progress report, December 1, 1989–November 30, 1990, 15:37340 (R;US)
CARCINOGENS
Accelerator mass spectrometry in the biomedical sciences: Applications in low-exposure biomedical and environmental dosimetry, 15:37653 (R;US)
Biological (molecular and cellular) markers of toxicity: Semiannual technical progress report No. 3, October 1, 1989–March 31, 1990, 15:37677 (R;US)
CASINGS (WELL)
See WELL CASINGS
CATALYSIS
Frequency response method for the study of kinetics of a heterogeneous catalytic reaction of gases, 15:37216 (J;US)
CATALYST SUPPORTS
Evidence for cluster sites on catalytic alumina, 15:37213 (J;US)
Mechanism of hydrodenitrogenation: Part 1, Preparation and characterization of acidic supports, 15:36696 (R;US)
CATALYSTS
Study of the destruction of coke and of its precursors in presence of hydrogen on platinum base catalysts, 15:36728 (R;FR;In French)
CATHODES
Poisoning studies of an osmium-coated dispenser cathode, 15:37504 (J;US)
CAVITY RESONATORS
See also SUPERCONDUCTING CAVITY RESONATORS
High repetition rate kickers for linear colliders, 15:37476 (RA;US)
Short RF pulse propagation in a traveling wave structure, 15:37480 (RA;US)
CDF
Research in elementary particle physics: Technical progress report, June 1, 1989–May 31, 1990, 15:37753 (R;US)
CEBAF ACCELERATOR
Modular magnet current regulator, 15:37468 (RA;US)
CELLS (BACTERIAL)
See BACTERIA
CELLULASE
Cellulase: A key enzyme for fermentation feedstocks: Progress report, September 1, 1987–August 31, 1988, 15:37631 (R;US)
Cellulase: A key enzyme for fermentation stocks: Final report, 1987–1989, 15:37632 (R;US)
Cellulase: A key enzyme for fermentation stocks: Progress report, 1989–1990, 15:37633 (R;US)
CELLULASES
See CELLULASE
CELLULOSE
Factors controlling decomposition in arctic tundra and related root mycorrhizal processes: [Progress report], 15:37635 (R;US)
CEMENTS
Adaptation of magnesian cements to underground storage of nuclear wastes, 15:36779 (R;FR;In French)
CENTRAL RECEIVER TEST FACILITY
Redirector design for testing surfaces of revolution at central receiver facilities, 15:36849 (J;US)
CENTRAL RECEIVERS
Optimizing the value-to cost ratio for central receiver electric power plants, 15:36848 (J;US)
Results of the design and testing of a porous ceramic absorber for a volumetric air receiver, 15:36846 (R;US)
CENTRIFUGE ENRICHMENT PLANTS
Safeguards training course: Nuclear material safeguards for enrichment plants: Part 4, Gas centrifuge enrichment plant: Diversion scenarios and safeguards activities, 15:36812 (R;US)
CERAMICS
Determination of the stress distributions in a ceramic: Tensile specimen using numerical techniques, 15:37229 (R;US)
Metals and Ceramics Division progress report for period ending September 30, 1989, 15:37192 (R;US)
Outlook for ceramics in heat engines, 1990–2010: A technical and economic assessment based on a worldwide Delphi survey, 15:37156 (R;US)
Technique for tensile creep testing of ceramics, 15:37253 (J;US)
CERIUM 139
Standardization of radioactivity, 15:37939 (RA;ZA)
CERIUM BORIDES
Density-of-states-driven transition from superconductivity to ferromagnetism in $Ce(Ru_{1-x}Rh_x)_3B_2$: Scenario for an exchange-split Kondo resonance, 15:37271 (J;US)
CERIUM COMPOUNDS
See also CERIUM BORIDES
Frequency mixing in de Haas–van Alphen oscillations in heavy-fermion compounds, 15:37220 (J;US)
Searching for heavy fermion materials in Ce intermetallic compounds, 15:37189 (R;US)
CERN II SYNCHROTRON
See CERN SPS SYNCHROTRON
CERN SPS SYNCHROTRON
Experimental results concerning global observables from the CERN SPS heavy ion program, 15:37752 (R;US)
CESIUM
A visible plasma, 15:38065 (BA;US)
Dependence of H^- production upon the work function of a Mo surface in a cesiated hydrogen discharge, 15:37211 (J;US)
CESIUM 137
Interim report on low-cost cesium radiation sources from Hanford Waste Management Program, 15:36815 (R;US)
Off-Site Radiation Exposure Review Project: Phase 2 soils program: Revision, 15:37596 (R;US)
Operation of a mobile pilot-scale continuous countercurrent ion exchange system for treatment of low-level radioactive wastewaters, 15:36774 (R;US)
Reversibility of interaction of cesium with clay minerals, mud suspensions, and sediments of Dutch surface water bottom: Final report cesium project by request of DBW/RIZA, 15:37602 (R;NL;In Dutch)
Viscosity, electrical conductivity, and cesium volatility of ORNL [Oak Ridge National Laboratory] vitrified soils with limestone and sodium additives, 15:36785 (R;US)
CESIUM BROMIDES
Structure of the dimer compounds $Cs_3R_2Br_9$ (R = Tb, Dy, Ho, Er, Yb) at 8 and 295 K studied by neutron diffraction, 15:37172 (J;US)
CFFF
See MHD GENERATOR CFFF
CHALKS
See LIMESTONE
CHANNELING
Channeling at higher energy, 15:37951 (RA;JP;In Japanese)
CHARGED PARTICLES
See also ALPHA PARTICLES
DEUTERONS
IONS
TRITONS
Charged particle distributions in heavy ion collisions at 14.6 GeV A/c, 15:37824 (R;US)
CHARGED-PARTICLE ACTIVATION
See CHARGED PARTICLES
CHARGED-PARTICLE TRANSPORT
Alternative forms of the Spencer-Fano equation, 15:37934 (J;US)
Joint proposal for US/USSR on nonlinear dynamics and plasma transport: Progress report, September 1989–September 14, 1990, 15:38024 (R;US)
CHARM PARTICLES
Selected topics from NA14': charm production and new results on D_s decays, 15:37769 (R;FR)
CHARPAK CHAMBERS
See MULTIWIRE PROPORTIONAL CHAMBERS
CHARPY TEST
Influence of thermal conditioning media on Charpy specimen test temperature, 15:37393 (R;US)
The use of flattened specimens to measure the Charpy V-notch impact properties of thin-wall pipe, 15:36746 (R;US)
CHEMICAL ANALYSIS
Analytical Chemistry Division annual progress report for period ending December 31, 1989, 15:37334 (R;US)

CHEMICAL COMPOSITION
Verification of product quality from process control, 15:36776 (R;US)
CHEMICAL ENGINEERING
Comprehensive Self-Assessment and Upgrade Program (CSAUP) performance objectives and criteria, 15:36806 (R;US)
CHEMICAL EXPLOSIONS
Experimental and computational investigation of the fundamental mechanisms of cratering, 15:37399 (R;US)
CHEMICAL EXPLOSIVES
See also SHAPED CHARGES
TNT
High explosives skid impact initiation study, 15:37550 (R;US)
Hypervelocity explosive launchers, 15:37549 (R;US)
The EISI [Elemental and Interplanar Spacing Index] index—A search/match tool for electron diffraction phase analysis, 15:38347 (R;US)
[Packaging regulations for chemical explosives]: Foreign trip report, January 26, 1988–February 1, 1988, 15:37552 (R;US)
CHEMICAL FEEDSTOCKS
Comparison of ethanol recovery processes from an immobilized cell reactor-separator, 15:37144 (R;US)
CHEMICAL REACTION KINETICS
Dynamics of classical systems based on the principle of stationary action, 15:37362 (J;US)
Fine chemistry, 15:37343 (R;FR;In French)
CHEMICAL REACTIONS
Reaction mechanisms, 15:37344 (R;FR;In French)
CHEMICAL REACTORS
Slurry reactor design studies: Topical report, Reactor selection criteria, 15:36697 (R;US)
CHEMICAL VAPOR DEPOSITION
Laser techniques for studying chemical vapor deposition, 15:37239 (R;US)
CHEMICAL WARFARE AGENTS
Constitutional implications of implementing a chemical weapons convention, 15:37559 (R;US)
Evaluating protective actions for chemical agent emergencies, 15:37560 (R;US)
Johnston Atoll Chemical Agent Disposal System (JACADS) Final Second Supplemental Environmental Impact Statement (SSEIS): Volume 2, Comments received from the public and agencies on the Draft Second Supplemental Environmental Impact Statement (SSEIS), 15:37618 (R;US)
Johnston Atoll Chemical Agent Disposal System (JACADS): Volume 1, Final Second Supplemental Environmental Impact Statement (SSEIS) for the storage and ultimate disposal of the European chemical munition stockpile, 15:37617 (R;US)
Reentry planning: The technical basis for offsite recovery following warfare agent contamination, 15:37561 (R;US)
CHEMISTRY
See also ATMOSPHERIC CHEMISTRY
Chemical Technology Division progress report for the period July 1, 1988 to September 30, 1989, 15:37327 (R;US)
Quantum chemistry and scientific calculus, 15:37342 (R;FR;In French)
CHERNOBYLSK-4 REACTOR
'Chernobyl' in the public opinion of the Federal Republic of Germany - risk perception, political attitudes and information, 15:37025 (R;DE;In German)
CHI RESONANCES
See MESONS
CHI-2800 RESONANCES
See MESONS
CHI-3455 RESONANCES
See MESONS
CHLORINATED ALIPHATIC HYDROCARBONS
See also CHLOROFORM
Engineering-scale experiments of solar photocatalytic oxidation of trichloroethylene, 15:36856 (R;US)
Microbial biomass and activities associated with subsurface environments contaminated with chlorinated hydrocarbons, 15:37626 (J;US)
CHLORINATED AROMATIC HYDROCARBONS
Environmental compliance assessment findings for Weldon Spring Site Remedial Action Program, 15:36805 (R;US)
CHLOROFORM
Macromolecular coal structure as revealed by novel diffusion tests: Quarterly technical report, January 15, 1990–April 15, 1990, 15:36703 (R;US)
CHONDROSARCOMAS
See SARCOMAS
CHOOZ REACTOR
See ARDENNES REACTOR
CHROMATID DELETIONS
See CHROMOSOMAL ABERRATIONS
CHROMIUM 52 TARGET
Nuclear-structure effects in proton evaporation spectra, 15:37865 (J;US)
CHROMIUM ALLOYS
See also ALLOY-NI73CR15FE7TI3
Development of surface treatments and alloy modifications for corrosion-resistant oxide scales, 15:36692 (R;US)
Moisture-induced embrittlement of Fe_3Al, 15:36690 (R;US)
CHROMODYNAMICS
See QUANTUM CHROMODYNAMICS
CHROMOSOMAL ABERRATIONS
Testing methodologies, 15:37663 (R;US)
CHROMOSOME ABERRATIONS
See CHROMOSOMAL ABERRATIONS
CHROMOSOME EXCHANGES
See CHROMOSOMAL ABERRATIONS
CHROMOSOME FRAGMENTS
See CHROMOSOMAL ABERRATIONS
CLASSIFIED INFORMATION
Special nuclear material information, security classification guidance. Instruction, 15:36813 (R;US)
CLATHRATES
[Drug-DNA interactions studied by x-ray crystallography]: [Progress report], 15:37636 (R;US)
CLIMATE MODELS
Simulating climate with two different numerical schemes, 15:37565 (R;US)
CLIMATES
Research on CO_2-induced climate change: Final report, 15:37566 (R;US)
CLUSTERS (FUEL ELEMENTS)
See FUEL ELEMENT CLUSTERS
CLUSTERS (SOLID)
See SOLID CLUSTERS
COAL
A large amplitude oscillating combustor, 15:36715 (BA;US)
A study of coal particle shape and three-body wear: Quarterly report, January 1990–March 1990, 15:36704 (R;US)
Advanced study in solid transport: Rheological behavior of dense suspension: Sixth quarterly report, January 1, 1990–March 31, 1990, 15:36711 (R;US)
Annual prospects for world coal trade 1990, 15:36718 (R;US)
Bioprocessing of fossil fuels program: Summary of advanced research and technology development sponsored activities for the period October 1, 1989–December 31, 1989, 15:36701 (R;US)
Chemical and biodesulfurization systems for removal of organic sulfur from coal: A critical review, 15:36702 (R;US)
Contribution to the study of low temperature pyrolysis of Gardanne coal, 15:36698 (R;FR;In French)
International competitiveness of clean coal technologies, 15:36717 (R;US)
Macromolecular coal structure as revealed by novel diffusion tests: Quarterly technical report, January 15, 1990–April 15, 1990, 15:36703 (R;US)
Microbial liquefaction of peat for the production of synthetic fuels: Final progress report, 15:36694 (R;US)
Modeling and measurements in coal-water slurry combustion for direct-fired gas turbine applications, 15:36714 (BA;US)
New ignition phenomenon in coal combustion, 15:36716 (J;US)

Supercritical fluid thermodynamics for coal processing: Quarterly progress report, January 1, 1990–March 31, 1990, 15:36695 (R;US)
Surface properties of coal and their role in coal beneficiation: Final report, 15:36705 (R;US)
Ultra-fine coal characterization: Final report, 15:36689 (R;US)

COAL-OIL MIXTURES
See COAL
FUEL OILS
FUEL SLURRIES

COASTAL REGIONS
Impact of accelerated sea level rise on coastal energy facilities, U.S.A., 15:37625 (BA;US)

COATINGS
See also ENERGY BEAM DEPOSITION FILMS
Design and fabrication of high damage threshold turning mirrors for the Nova laser, 15:37244 (R;US)
Diffuse absorbing beryllium coatings produced by magnetron sputtering, 15:37182 (R;US)
Mechanical properties of coatings and interfaces, 15:37225 (R;US)
Mechanical properties of silica coatings, 15:37226 (R;US)
Sol-gel coating on acoustic wave devices: Thin film characterization and chemical sensor development, 15:37238 (R;US)
Tribology: Coatings. October 1976-March 1990 (A Bibliography from the COMPENDEX data base). Report for October 1976-March 1990, 15:37153 (R;US)

COBALT
Study of the mechanism of fast diffusion of cobalt in thorium by diffusion and internal friction measurements, 15:37210 (J;US)

COBALT 60
Investigation of radiation effects in Hiroshima and Nagasaki using a general Monte Carlo-discrete ordinates coupling scheme, 15:37932 (R;US)

COBALT ALLOYS
Microstructure of melt spun Nd-Fe-Co-B magnets, 15:37209 (J;US)

COBALT COMPLEXES
Gas-phase photoinduced reactivity of Co_2NO^+ with O_2 via a photoisomerization mechanism, 15:37329 (J;US)
Kinetics of oxidation of cobalt(II) macrocyclic complexes by tris(bipyridyl)ruthenium(3+) ion, 15:37349 (R;US)

COBALT OXIDES
A study of a new incommensurate phase in the system $SrMn_{1-x}Co_xO_{3-y}$, 15:37167 (J;US)

COHERENT RADIATION
A micro-fabrication compatible wiggler design scalable to submillimeter periods, 15:38282 (BA;US)

COILS (MAGNETIC)
See MAGNET COILS

COLD NEUTRONS
See also ULTRACOLD NEUTRONS
Neutron reflectometer, 15:37522 (RA;JP;In Japanese)

COLD PLASMA
Electron motion in a nonlinear magnetosonic wave propagating perpendicularly to a magnetic field, 15:38037 (R;JP)

COLLECTIVE ACCELERATORS
See also PLASMA BETATRONS
Numerical simulation of collective ion acceleration in the laser controlled collective accelerator, 15:38280 (BA;US)

COLLEGES
See EDUCATIONAL FACILITIES

COLLIDER DETECTOR AT FERMILAB
See CDF

COLLIDING BEAMS
Coherent instability limitations of Fermilab's upgrades, 15:37455 (R;US)
IR design and parameters of APIARY VI, 15:37454 (R;US)
Influence of collective effects on the performance of high-luminosity colliders, 15:37453 (R;US)

COLLISIONLESS PLASMA
Experimental and simulation studies of collisionless plasma flow, 15:38278 (BA;US)
Numerical and theoretical developments in plasma erosion opening switch research, 15:38287 (BA;US)
Prospect of multiphoton induced inner shell excitations for x-ray laser pumping, 15:38296 (BA;US)

COLOGNE SPIRITS
See ETHANOL

COLUMNS (MECHANICAL)
See MECHANICAL STRUCTURES

COMBINED SOXNOX PROCESSES
Combined nitrogen oxides/sulfur dioxide control in a spray-dryer/fabric-filter system: Summary report for the Field Research Program, 15:36895 (R;US)
Combined nitrogen oxides/sulfur dioxide control in dry scrubber systems: Volume 2, Evaluation of additives and process modifications: Appendixes, 15:36894 (R;US)

COMBUSTION PRODUCTS
International competitiveness of clean coal technologies, 15:36717 (R;US)

COMBUSTORS
See also FLUIDIZED-BED COMBUSTORS
PULSE COMBUSTORS
A large amplitude oscillating combustor, 15:36715 (BA;US)

COMMERCIAL BUILDINGS
Measurement of energy performance in a small bank building, 15:37121 (R;US)

COMMUNICATIONS
It's not hype, it's communication: Using public relations techniques to improve your technical messages, 15:38344 (R;US)

COMPACT IGNITION TOKAMAK
Accidents
Safety implications of a graphite oxidation accident in the Compact Ignition Tokamak device, 15:38248 (RA;US)
Control Systems
Plasma vertical stability and feedback control for CIT, 15:38146 (RA;US)
Design
Physics overview of CIT, 15:38201 (RA;US)
Systems integration approach to developing component arrangements, the test facility, and maintenance for the Compact Ignition Tokamak, 15:38159 (RA;US)
Ecr Heating
Physics study of the application of an IFEL [Induction Free-Electron Laser] to CIT [Compact Ignition Tokamak]: Interim report, 15:38275 (R;US)
Limiters
A carbon-carbon panel design concept for the inboard limiter of the Compact Ignition Tokamak (CIT), 15:38132 (RA;US)
Magnets
A code for calculating force and temperature of a bitter plate type toroidal field coil system, 15:38176 (RA;US)
Coupled eddy current and thermodynamic analysis with the SPARK code, 15:38177 (RA;US)
Design and R and D for the central solenoid for the Compact Ignition Tokamak (CIT), 15:38096 (RA;US)
Electrothermal evaluation of conductors for the Compact Ignition Tokamak (CIT) PF coils, 15:38097 (RA;US)
Equilibrium shape control in CIT PF design, 15:38123 (RA;US)
Evaluation of alumina dispersion strengthened (ODS) copper for possible use in the central solenoid and TF coils for the compact ignition tokamak (CIT), 15:38095 (RA;US)
Liquid nitrogen cooling for the compact ignition tokamak, 15:38182 (RA;US)
Plasma vertical stability and feedback control for CIT, 15:38146 (RA;US)
Poloidal field coil system optimization for the Compact Ignition Tokamak (CIT), 15:38099 (RA;US)
Preliminary design of the CIT cryostat, 15:38183 (RA;US)
Preliminary power supply design for the TF coil system of CIT, 15:38189 (RA;US)
Structural analysis of the toroidal field coils for the Compact Ignition Tokamak (CIT), 15:38218 (RA;US)
The CIT toroidal field coil and structure design and assembly approach, 15:38217 (RA;US)

Maintenance
Systems integration approach to developing component arrangements, the test facility, and maintenance for the Compact Ignition Tokamak, 15:38159 (RA;US)
Neutral Beam Sources
Assessment of possible implications of a neutral beam configuration for CIT, 15:38149 (RA;US)
Optimization
Physics optimization of the Compact Ignition Tokamak (CIT), 15:38194 (RA;US)
Planning
IGNITEX experiment, 15:38294 (BA;US)
Power Supplies
Nuclear radiation analysis of the IGNITEX experiment, 15:38295 (BA;US)
Radiation Hazards
Safety analysis of the Compact Ignition Tokamak (CIT) release of activated solid material, 15:38247 (RA;US)
Safety
Safety analysis of the Compact Ignition Tokamak (CIT) release of activated solid material, 15:38247 (RA;US)
Test Facilities
Systems integration approach to developing component arrangements, the test facility, and maintenance for the Compact Ignition Tokamak, 15:38159 (RA;US)
Thermonuclear Reactor Cooling Systems
Liquid nitrogen cooling for the compact ignition tokamak, 15:38182 (RA;US)
Thermonuclear Reactor Fueling
The CIT pellet injection system: Description and supporting research and development, 15:38197 (RA;US)
Vacuum Systems
Compact Ignition Tokamak, vacuum vessel, design and development, 15:38141 (RA;US)

COMPACT TORUS
See also FIELD-REVERSED THETA PINCH DEVICES
COMPASS mechanical design and construction, 15:38115 (RA;US)

COMPLIANCE
On the implementation of complex many-to-many relations in focus, 15:38321 (R;US)

COMPOSITE MATERIALS
See also SUPERCONDUCTING COMPOSITES
Development of composite polymer-glass edge claddings for Nova Laser Disks, 15:37413 (BA;US)
Laser ultrasonic measurements on ceramic materials with rough surfaces, 15:37232 (R;US)
Operational readiness review plan for the radioisotope thermoelectric generator materials production tasks, 15:37043 (R;US)
Thermal expansion of beta-eucryptite filled bismaleimide and glass/bismaleimide composites, 15:37295 (R;US)

COMPOUNDS (ORGANIC)
See ORGANIC COMPOUNDS

COMPUTER CALCULATIONS
Software supervisor: extension to the on-line codes utilization in order to help the process control, 15:38314 (R;FR;In French)
[Optimal design and analysis of experiments]: Foreign trip report, July 16–August 5, 1988, 15:38324 (R;US)
[Optimal design and analysis of experiments]: Foreign trip report, July 22–29, 1988, 15:38323 (R;US)

COMPUTER CODES
See also A CODES
F CODES
G CODES
I CODES
P CODES
W CODES
Application of the finite-element program NAMMU for a model of a radioactive waste repository site, 15:36765 (R;DE;In German)
Optimizing the value-to cost ratio for central receiver electric power plants, 15:36848 (J;US)
Redirector design for testing surfaces of revolution at central receiver facilities, 15:36849 (J;US)

COMPUTER PROGRAMMING
See PROGRAMMING

COMPUTER PROGRAMS
See COMPUTER CODES

COMPUTER-AIDED DESIGN
OMNI development of an engineering product data management system, 15:38320 (R;US)

COMPUTER-AIDED MANUFACTURING
Information engineering: Sandia's Computer Integrated Manufacturing (CIM) database, 15:38313 (R;US)
Integrating expert systems with solid modeling through interprocess communications and the applications interface specification, 15:38319 (R;US)
OMNI development of an engineering product data management system, 15:38320 (R;US)

COMPUTERIZED CONTROL SYSTEMS
Model-based expert systems for linac computer controls, 15:37471 (RA;US)

CONDUCTIVITY (ELECTRIC)
See ELECTRIC CONDUCTIVITY

CONING
See CHANNELING

CONSERVATION (ENERGY)
See ENERGY CONSERVATION

CONSOLIDATED FUEL REPROCESSING PROGRAM
Designing equipment for use in gamma radiation environments, 15:36759 (R;US)

CONTAINMENT
See also CONTAINMENT BUILDINGS
CONTAINMENT SYSTEMS
Recent developments in the CONTAIN-LMR code, 15:36987 (R;US)

CONTAINMENT BUILDINGS
Leak rate test of containment personnel lock, 15:36978 (RA;US)

CONTAINMENT SYSTEMS
Filtered containment venting systems for Swiss LWR's - proposed design requirements and principles, 15:36976 (RA;US)
Filtered vented containments, 15:36977 (RA;US)

CONTAMINATION
See also SURFACE CONTAMINATION
Radiation safety management during a TFTR shutdown, 15:38249 (RA;US)

CONTAMINATION (SURFACE)
See SURFACE CONTAMINATION

CONTENT ANALYSIS
See CHEMICAL ANALYSIS

CONTROL SYSTEMS
See also COMPUTERIZED CONTROL SYSTEMS
ENTRY CONTROL SYSTEMS
REACTOR CONTROL SYSTEMS
PC-Link historical data base system MODCOMP/IBM at link for neutral particle beam operation, 15:38243 (RA;US)
The design of the CPRF (Confinement Physics Research Facility) control system, 15:38244 (RA;US)

CONTROLLED TERMINOLOGY
See STANDARDIZED TERMINOLOGY

CONVECTIVE LOOP HOUSES
See DOUBLE ENVELOPE BUILDINGS

CONVENTIONAL WARFARE
Arsenal of democracy in the face of change: Issues underlying the implementation of industrial mobilization policy: Working paper No. 3, 15:37548 (R;US)

COOLANT LOOPS
Advances on the analysis of fast reactor core and coolant circuit structures, 15:36996 (BA;US)

COOLERS
See HEAT EXCHANGERS

COOLING SYSTEM (REACTOR)
See REACTOR COOLING SYSTEMS

COOLING SYSTEMS
See also COOLANT LOOPS
REACTOR COOLING SYSTEMS
THERMONUCLEAR REACTOR COOLING SYSTEMS

Recommendations for a cryogenic system for ITER (International Thermonuclear Experimental Reactor), 15:38181 (RA;US)

COOLING TOWERS
B-Factory mechanical utilities operation without SLC, 15:37485 (R;US)

COPPER
Evaluation of alumina dispersion strengthened (ODS) copper for possible use in the central solenoid and TF coils for the compact ignition tokamak (CIT), 15:38095 (RA;US)
Evidence of hydrodynamic processes in multimegampere copper fuses, 15:38307 (J;US)
GlidCop dispersion strengthened copper: Potential applications in fusion power generators, 15:38103 (RA;US)
Material characteristics related to the fracture and particulation of electrodeposited-copper shaped charge jets, 15:37198 (R;US)
Microstructural dependence of the cavitation damage function in FCC materials: Progress report, March 1, 1989–February 28, 1990, 15:37185 (R;US)
Nanoindentation study of the mechanical properties of copper-nickel multilayered thin films, 15:37205 (J;US)
New measurements of the elastic properties of composition modulated Cu-Ni thin films, 15:37207 (J;US)

COPPER 65 TARGET
Models and theory for precompound angular distributions, 15:37909 (R;US)

COPPER ALLOYS
Center conductor design for the compact Spherical Torus reactor, 15:38126 (RA;US)
Electrothermal evaluation of conductors for the Compact Ignition Tokamak (CIT) PF coils, 15:38097 (RA;US)
Nuclear radiation analysis of the IGNITEX experiment, 15:38295 (BA;US)

COPPER CHLORIDES
Enhanced ionic conductivity in composite electrolytes, 15:37307 (BA;US)

COPPER COMPOUNDS
See also COPPER OXIDES
Characterization of the strength and microstructural evolution of a heavily cold rolled Cu-20% Nb composite, 15:37254 (J;US)
Magnetic field dependence of the specific heat of heavy-fermion $YbCu_{4.5}$, 15:37288 (R;US)

COPPER OXIDES
Ablation
In situ processing of textured superconducting thin film of Bi(-Pb)-Ca-Sr-Cu-O by excimer laser ablation, 15:37256 (J;US)
Absorption Spectra
Determination of the valence of Pr, Gd, and Ho in $YBa_2Cu_3O_7$ by x-ray absorption spectroscopy, 15:37221 (J;US)
Atom Transport
Monte Carlo study of tracer and chemical diffusion of oxygen in $YBa_2Cu_3O_{6+2c}$, 15:37273 (J;US)
Bromination
Metallization and superconducting properties of $YBa_2Cu_3O_{6.2}Br_y$, 15:37275 (J;US)
Critical Current
Large, orientation-dependent enhancements of critical currents in $Y_1Ba_2Cu_3O_{7-x}$ epitaxial thin films: Evidence for intrinsic flux pinning?, 15:37228 (R;US)
Neutron-induced microwave loss in ceramic $YBa_2Cu_3O_{7-\delta}$, 15:37259 (J;US)
Rapid thermal processing of $YBa_2Cu_3O_7$ spun wires, 15:37261 (J;US)
Transport critical current density and microstructure in extruded $YBa_2Cu_3O_{7-x}$ wires processed by zone melting, 15:37250 (J;US)
Crystal Doping
Strontium-induced oxygen defect structure and hole doping in $La_{2-x}Sr_xCuO_4$ (B), 15:37260 (J;US)
Crystal-Phase Transformations
Numerical investigation of a model for oxygen ordering in $YBa_2Cu_3O_{6+x}$, 15:37265 (J;US)
Deposition
Theoretical model for deposition of superconducting thin films using pulsed laser evaporation technique, 15:37251 (J;US)
Dielectric Properties
Temperature and frequency dependences of the dielectric properties of $YBa_2Cu_3O_{6+x}$ ($x \approx 0$), 15:37270 (J;US)
Electronic Structure
Renormalization from density-functional theory to strong-coupling models for electronic states in Cu-O materials, 15:37985 (J;US)
Growth
Y-Ba-Cu-O thin films grown on rigid and flexible polycrystalline yttria-stabilized zirconia by pulsed laser ablation, 15:37249 (J;US)
Heat Treatments
Rapid thermal processing of $YBa_2Cu_3O_7$ spun wires, 15:37261 (J;US)
Some observations of the effects of high pressures and temperatures on the stability of $YBa_2Cu_3O_{7-x}$, 15:37355 (J;US)
Magnetic Flux
Effect of microstructural changes on thermally activated flux-creep behavior in the Bi-Sr-Ca-Cu-O system, 15:37267 (J;US)
Increase in the flux-pinning energy of $YBa_2Cu_3O_{7-\delta}$ by shock compaction, 15:37255 (J;US)
Magnetic Properties
Muon-spin-relaxation and neutron-scattering studies of magnetism in single-crystal $La_{1.94}Sr_{0.06}CuO_4$, 15:37268 (J;US)
Two- and three-dimensional magnetic order of the rare-earth ions in $RBa_2Cu_4O_8$, 15:37277 (J;US)
Mechanical Properties
Increase in the flux-pinning energy of $YBa_2Cu_3O_{7-\delta}$ by shock compaction, 15:37255 (J;US)
Microstructure
Transport critical current density and microstructure in extruded $YBa_2Cu_3O_{7-x}$ wires processed by zone melting, 15:37250 (J;US)
Phase Diagrams
Phase diagram and low-temperature behavior of oxygen ordering in $YBa_2Cu_3O_z$ using *ab initio* interactions, 15:37263 (J;US)
Physical Radiation Effects
Neutron-induced microwave loss in ceramic $YBa_2Cu_3O_{7-\delta}$, 15:37259 (J;US)
Strongly enhanced flux pinning by high-energy proton irradiation of a $Tl_2Ca_2Ba_2Cu_3O_y$ single crystal, 15:37258 (J;US)
Raman Spectra
Raman-active phonons of a twin-free $YBa_2Cu_3O_7$ crystal: A complete polarization analysis, 15:37266 (J;US)
Raman Spectroscopy
Superconducting La_2CuO_{4+x} prepared by oxygenation at high pressure: A Raman scattering study, 15:37242 (R;US)
Solubility
Copper(II) oxide solubility behavior in aqueous sodium phosphate solutions at elevated temperatures, 15:37236 (R;US)
Spin-Lattice Relaxation
Spin and charge excitations in $YBa_2Cu_3O_7$: Constraints from spin-relaxation rates in the normal state, 15:37274 (J;US)
Superconductivity
Filled-band model leading to supercurrents in La-Ba-Cu-O, 15:37269 (J;US)
Metallization and superconducting properties of $YBa_2Cu_3O_{6.2}Br_y$, 15:37275 (J;US)
Superconducting thin-film multiturn coils of $YBa_2Cu_3O_{7-x}$, 15:37420 (J;US)
Superconductivity and oxygen ordering in $(Ca,Ba,La)Cu_3O_{7-\delta}$, 15:37276 (J;US)
In situ processing of textured superconducting thin film of Bi(-Pb)-Ca-Sr-Cu-O by excimer laser ablation, 15:37256 (J;US)
Thermal Conductivity
Thermal conductivity of single-crystal Bi-Sr-Ca-Cu-O, 15:37272 (J;US)
Thermoelectric Properties
Thermoelectric power measurements of $CuCr_{2-x}Al_xO_4$ and $Cu_{1-x}Mg_xCr_2O_4$ solid solution spinel oxides, 15:37169 (J;US)
Transition Temperature
Rapid thermal processing of $YBa_2Cu_3O_7$ spun wires, 15:37261 (J;US)
Superconductivity under high pressure of $YBa_2(Cu_{1-xMx})_3O_{7-\delta}$ (*M*=Fe, Co, Al, Cr, Ni, and Zn), 15:37264 (J;US)

CORES (REACTOR)
See REACTOR CORES
CORIUM
The AFDM [advanced fluid dynamics model] program: Scope and significance, 15:36926 (R;US)
COSMIC GAMMA BURSTS
X-ray observations of gamma-ray burst sources, 15:37692 (R;DE)
COSMIC PARTICLES
See COSMIC RADIATION
COSMIC RADIATION
Acceleration and propagation of cosmic rays. Production, oscillation and detection of neutrinos, 15:37691 (R;FR;In French)
Gamma-ray astronomy at 1 TeV, 15:37697 (J;US)
Solar-Geophysical Data Number 546, February 1990. Part 1 (prompt reports). data for January 1990, December 1989, and late data, 15:37693 (R;US)
COSMIC RAY PROPAGATION
Acceleration and propagation of cosmic rays. Production, oscillation and detection of neutrinos, 15:37691 (R;FR;In French)
COSMOGONY
See COSMOLOGY
COSMOLOGICAL MODELS
Eternal annihilations: New constraints on long-lived particles from big-bang nucleosynthesis, 15:37703 (J;US)
COSMOLOGY
Constraints for toroidal cosmology, 15:37702 (J;US)
COSMOS
See UNIVERSE
COST ESTIMATION
Hanford Waste Vitrification Plant foreign alternatives feasibility study: Revision 1, 15:36777 (R;US)
COUNTERFLOW COOLING TOWERS
See COOLING TOWERS
COUNTERS (RADIATION)
See RADIATION DETECTORS
COUPLING
A magnetically coupled Stirling engine driven heat pump: Design optimization and operating cost analysis, 15:37143 (R;US)
CP INVARIANCE
Origin of CP violation, 15:37807 (RA;JP;In Japanese)
Present status of the NA31 experiment, 15:37771 (R;FR)
Some issues in elementary particle physics involving low-energy neutrons and antiprotons focusing on measurement of violated symmetry, 15:37792 (RA;JP;In Japanese)
CPT THEOREM
Some issues in elementary particle physics involving low-energy neutrons and antiprotons focusing on measurement of violated symmetry, 15:37792 (RA;JP;In Japanese)
CRITICAL CURRENT
NDE [nondestructive evaluation] of critical currents in high T_c superconductors, 15:37233 (R;US)
CRITICALITY
Forecast of criticality experiments needed to support US DOE contractor operations, 1987–1992, 15:36800 (R;US)
CRITICALITY ACCIDENTS
See CRITICALITY
RADIATION ACCIDENTS
CROSSED BEAMS
See COLLIDING BEAMS
CROSSFLOW COOLING TOWERS
See COOLING TOWERS
CRUDE OIL
See PETROLEUM
CRYOPUMPS
Co-pumping of deuterium-helium and tritium-helium mixtures at TSTA, 15:38135 (RA;US)
CRYOSTATS
Large-load cryostat for UTS, 15:37376 (RA;JP;In Japanese)
Preliminary design of the CIT cryostat, 15:38183 (RA;US)
CRYSTALS
See also MOLECULAR CRYSTALS
POLYCRYSTALS
Electromagnetic radiation from doubly rotated piezoelectric crystal plates vibrating at thickness frequencies, 15:37970 (J;US)
Four-wave mixing of Nd^{3+}-doped crystals and glasses, 15:37324 (J;US)
[Drug-DNA interactions studied by x-ray crystallography]: [Progress report], 15:37636 (R;US)
[Symposium on dynamic particle-condensed matter interactions]: Foreign trip report, November 28, 1988–December 9, 1988, 15:37950 (R;US)
CUMULATIVE EFFECT
See PARTICLE PRODUCTION
CURIUM 248 TARGET
Heavy actinide production from the interactions of ^{40}Ar with ^{248}Cm and a comparison with the ^{44}Ca-^{248}Cm system, 15:37887 (J;US)
CURRENT-DRIVE HEATING
Current drive by spheromak injection into a tokamak, 15:38090 (J;US)
CURRENTS (BEAM)
See BEAM CURRENTS
CUTTING MACHINES
The use of the Deep Kerfer for thick, steel-reinforced concrete cutting, 15:36775 (R;US)
CYANOGEN
Smectic-layer growth at solid interfaces, 15:37314 (J;US)
CYCLOALKANES
Gas-phase photoinduced reactivity of $RhC_5H_6^+$ with cyclopentane, 15:37328 (J;US)
CYSTEINE
Use of ferrous chelates for NO_x control in aqueous scrubbers, 15:36707 (R;US)
CYTOLOGICAL TECHNIQUES
A CLIPS expert system for clinical flow cytometry data analysis, 15:37640 (R;US)

D

D NEUTRAL MESONS
Resonant substructure in $K^-\pi^+\pi^+\pi^-$ decays of D^0 mesons, 15:37783 (J;US)
D ZERO RESONANCES
See D NEUTRAL MESONS
D* PLUS RESONANCES
See BARYONS
D* ZERO RESONANCES
See BARYONS
D*RESONANCES
See BARYONS
D-1285 RESONANCES
See F1-1285 MESONS
D-T REACTORS
Activation evaluation of fusion solid breeder materials, 15:38171 (RA;US)
DATA
A decision support system based on stochastic comparisons, 15:38316 (R;US)
DATA ACQUISITION SYSTEMS
A human factors review of data entry devices, 15:38332 (R;US)
Data acquisition system realization for H1 experiment, 15:37527 (R;FR;In French)
STL [Simulation Technology Laboratory] Global Control System, technical reference, 15:37499 (R;US)
SouthWest Region Experiment Station (SWRES) 1989 report, 15:36843 (R;US)
DATA BASE MANAGEMENT
A methodology for benchmarking distributed database management systems, 15:38341 (R;US)
PR-EDB: Power Reactor Embrittlement Data Base, version 1: Program description, 15:36907 (R;US)
DATA PROCESSING
Data processing, 15:38318 (R;FR;In French)
DATA-FLOW PROCESSING
Controlled eager evaluation in a Dynamic-Arc Tagged-Token Dataflow Model, 15:38336 (R;US)

DAUGHTER PRODUCTS
Activation of oncogenes by radon progeny and x-rays, 15:37665 (R;US)
DECALSO
See ION EXCHANGE MATERIALS
DECANE
Quasielastic γ-ray scattering from pentadecane, 15:37336 (J;US)
DECAY PRODUCTS
See DAUGHTER PRODUCTS
DECHANNELING
See CHANNELING
DECISION MAKING
[Symposium on the Analytic Hierarchy Process]: Foreign trip report, September 2, 1988–September 11, 1988, 15:38325 (R;US)
DEEP INELASTIC SCATTERING
Parton distributions extracted from data on deep-inelastic lepton scattering, prompt photon production and the Drell-Yan process, 15:37789 (R;GB)
DEFORMATION
Oxidation and sulfidation of Type 310S stainless steel at elevated temperatures, 15:37183 (R;US)
DEFORMED NUCLEI
Level spin and moments of inertia in superdeformed nuclei near A = 194, 15:37882 (R;US)
DEHYDRATION
Membrane process designs in the recovery of bio-fuels and biochemicals, 15:37150 (R;US)
DELAYED NEUTRONS
Quantitative studies of severe fuel damage using delayed neutron data, 15:36938 (R;US)
DELETIONS (CHROMOSOMAL)
See CHROMOSOMAL ABERRATIONS
DELTA BARYONS
Delta isobar in (h,t) reactions, 15:37903 (RA;JP)
DELTA RESONANCES (MESON)
See MESONS
DELTA-2850 RESONANCES
See DELTA BARYONS
DENSITY (ELECTRON)
See ELECTRON DENSITY
DENSITY (PLASMA)
See PLASMA DENSITY
DEPLETED URANIUM
Long-term fate of depleted uranium at Aberdeen and Yuma Proving Grounds: Final report, Phase 1: Geochemical transport and modeling, 15:36795 (R;US)
DEPOSITION
Descriptions of research sites in the integrated forest study on effects of atmospheric deposition, 15:37678 (R;US)
DEPOSITS (GEOLOGICAL)
See GEOLOGIC DEPOSITS
DESERTRON
See SUPERCONDUCTING SUPER COLLIDER
DESERTS
Effect of manipulation of water and nitrogen supplies on the quantitative phenology of Larrea tridentata (creosote bush) in the Sonoran desert in California, 15:37611 (J;US)
DESONOX PROCESS
See COMBINED SOXNOX PROCESSES
DESULFOVIBRIO
Genetics and molecular biology of hydrogen metabolism in sulfate reducing bacteria: Progress report, May 1, 1987–December 1, 1989, 15:36819 (R;US)
DETECTORS (RADIATION)
See RADIATION DETECTORS
DEUTERIUM
Co-pumping of deuterium-helium and tritium-helium mixtures at TSTA, 15:38135 (RA;US)
The intramolecular kinetic isotope effect for the reaction $O(^3P)$+HD, 15:37363 (J;US)
dc electrical conductivity of D-T gas, 15:37319 (J;US)
DEUTERIUM HYDRIDE
See HYDROGEN DEUTERIDE
DEUTERIUM IONS
Charge transfer and electron detachment for collisions of H^- and D^- with H, 15:37731 (J;US)
Microsources of intense fusion in focused discharges of plasma focus, 15:38299 (BA;US)
DEUTERIUM TARGET
Beuhler, Friedman, and Friedlander reply, 15:37849 (J;US)
Comment on "Cluster-impact fusion", 15:37848 (J;US)
Construction and test of the Bonn frozen spin target, 15:37465 (R;DE;In German)
Exclusive photonuclear reactions and asymptotic scaling, 15:37916 (J;US)
DEUTERIUM TRITIDE
Deuteron polarization of solid DT, 15:38308 (J;US)
DEUTERIUM TRITIDES
See DEUTERIUM TRITIDE
DEUTERON REACTIONS
Beuhler, Friedman, and Friedlander reply, 15:37849 (J;US)
Comment on "Cluster-impact fusion", 15:37848 (J;US)
Light ion reaction, 15:37905 (RA;JP;In Japanese)
DEUTERON-DEUTERON INTERACTIONS
See DEUTERIUM TARGET
DEUTERON REACTIONS
DEUTERONS
The polarization observables and the short range deuteron structure, 15:37841 (R;FR;In French)
DEVELOPED COUNTRIES
Economic and Energy Indicators. Bi-weekly report, 15:37011 (R;US)
DEVELOPING COUNTRIES
See also EL SALVADOR
GUATEMALA
Forces shaping the energy required to support western hemisphere development, 15:37027 (R;US)
[Environmental toxicology]: Foreign trip report, November 11–21, 1988, 15:37674 (R;US)
DEVICES
See EQUIPMENT
DIABLO CANYON-1 REACTOR
Alarm Processing System, 15:36969 (R;US)
DIABLO CANYON-2 REACTOR
Alarm Processing System, 15:36969 (R;US)
DIAMONDS
Absolute x-ray power measurements with subnanosecond time resolution using type IIa diamond photoconductors, 15:37308 (J;US)
Total dose radiation hardness of diamond-based silicon-on-insulator structures, 15:37315 (J;US)
DIAPHRAGMS (THERMONUCLEAR DEVICE)
See LIMITERS
DIBARYON RESONANCES
See DIBARYONS
DIBARYONS
A proposal to study double-Λ hypernuclei and H-dibaryon by using a 4π-type spectrometer, 15:37761 (R;JP)
DIELECTRIC MATERIALS
A theory of weak transient electrical discharges on dielectric surfaces, 15:38094 (J;US)
DIELECTRICS
See DIELECTRIC MATERIALS
DIESEL ENGINES
Assessment of fundamental materials needs for thick thermal barrier coatings (TTBC's) for truck diesel engines, 15:37230 (R;US)
Emission and biological activity of N-containing polycyclic aromatic compound as exhaust of Diesel engines, 15:37158 (R;DE;In German)
Soot formation in fuel sprays, 15:36742 (BA;US)
DIESEL FUELS
Investigation of particulate formation during diesel spray combustion: Technical progress quarterly report, March 1–May 31, 1990, 15:37371 (R;US)
Soot formation in fuel sprays, 15:36742 (BA;US)

DIESEL OIL (FRACTION)
See DIESEL FUELS
DIFFERENTIAL PAC
A TDC-PC based DPAC spectrometer, 15:37956 (R;SE)
DIFFRACTION (NEUTRON)
See NEUTRON DIFFRACTION
DIFFRACTION (X-RAY)
See X-RAY DIFFRACTION
DIFFUSION
Equal eigenvalues in multicomponent diffusion: The extraction of diffusion coefficients from experimental data in ternary systems, 15:37955 (R;US)
Incorporation of an explosive cloud rise code into ARAC's [Atmospheric Release Advisory Capability] ADPIC transport and diffusion model, 15:37588 (R;US)
Species-diffusion phenomena in glass: A one-dimensional, transient model, 15:37297 (R;US)
Toward more realistic material models for release and dispersion of heavy gases, 15:37587 (R;US)
DIGESTER GAS
See METHANE
DIGITIZERS
Curve fitting and error modeling for the digitization process near the Nyquist rate, 15:37402 (R;US)
DIODE TRANSISTORS
See TRANSISTORS
DIODES (SEMICONDUCTOR)
See SEMICONDUCTOR DIODES
DIOXIN
Accelerator mass spectrometry in the biomedical sciences: Applications in low-exposure biomedical and environmental dosimetry, 15:37653 (R;US)
DIPHENYLPHOSPHINE OXIDE
See ORGANIC PHOSPHORUS COMPOUNDS
DIRAC EQUATION
The Dirac equation in a non-Riemannian manifold: II. An analysis using an internal local *n*-dimensional space of the Yang–Mills type, 15:37814 (J;US)
DISCHARGES (ELECTRIC)
See ELECTRIC DISCHARGES
DISKS (MAGNETIC)
See MAGNETIC DISKS
DISPERSANTS (CHEMICAL)
See SURFACTANTS
DISPERSE SYSTEMS
See DISPERSIONS
DISPERSION RELATIONS
Dispersion relations for causal Green's functions: Derivations using the Poincare–Bertrand theorem and its generalizations, 15:37994 (J;US)
DISPERSION THEORY
See DISPERSION RELATIONS
DISPERSIONS
See also MIXTURES
SUSPENSIONS
Bounds on the effective properties of polydispersed suspensions of spheres: An evaluation of two relevant morphological parameters, 15:37968 (J;US)
DISSOLVED OXYGEN
See OXYGEN
DIVERTORS
A high-speed beam of lithium droplets for collecting diverted energy and particles in ITER (International Thermonuclear Experimental Reactor), 15:38210 (RA;US)
Design of DIII-D advanced divertor, 15:38211 (RA;US)
Thermal design and analysis of DIII-D advanced divertor, 15:38133 (RA;US)
DNA ADDUCTS
Accelerator mass spectrometry in the biomedical sciences: Applications in low-exposure biomedical and environmental dosimetry, 15:37653 (R;US)
DNA SEQUENCING
Life Sciences Division and Center for Human Genome Studies Annual report 1989, 15:37637 (R;US)
DOUBLE ENVELOPE BUILDINGS
Building Thermal Envelope Systems and Materials (BTESM) and research utilization/technology transfer progress report for DOE Office of Buildings and Community Systems: Monthly progress report, 15:37122 (R;US)
DOUBLE FOCUSING SPECTROMETERS
See FLAT MAGNETIC SPECTROMETERS
DOUBLE SHELL HOUSES
See DOUBLE ENVELOPE BUILDINGS
DOUBLE WALL HOUSES
See DOUBLE ENVELOPE BUILDINGS
DOWTHERM
See BIPHENYL
DPO
See ORGANIC PHOSPHORUS COMPOUNDS
DRIFT (PLASMA)
See PLASMA DRIFT
DRIFT CHAMBERS
Calibration simulation. A calibration Monte-Carlo program for the OPAL jet chamber, 15:37511 (R;DE;In German)
DRILL HOLES
See BOREHOLES
DRILL SHIPS
See SHIPS
DRINKING WATER
New selective anion-exchange resins for nitrate removal from contaminated drinking water and studies on analytical anion-exchange chromatography, 15:37616 (R;US)
DRUG ABUSE
Development of a drug assay using surface-enhanced Raman spectroscopy, 15:37298 (R;US)
DRUGS
See also RADIOPHARMACEUTICALS
Development of a drug assay using surface-enhanced Raman spectroscopy, 15:37298 (R;US)
[Drug-DNA interactions studied by x-ray crystallography]: [Progress report], 15:37636 (R;US)
DRY DEPOSITION
See DEPOSITION
DRY-TYPE COOLING TOWERS
See COOLING TOWERS
DYE LASERS
Process margins for laser planarization of 1 to 5 μm gold films, 15:37958 (BA;US)
DYMAC SYSTEM
See NUCLEAR MATERIALS MANAGEMENT
DYNAMIC LOADS
See also WIND LOADS
Dynamics of the Ross-Stirling engine, 15:37401 (R;CA)
DYNAMIC MATERIALS ACCOUNTABILITY SYSTEM
See NUCLEAR MATERIALS MANAGEMENT
DYNAMICS (BEAM)
See BEAM DYNAMICS
DYSPROSIUM OXIDES
Two- and three-dimensional magnetic order of the rare-earth ions in $RBa_2Cu_4O_8$, 15:37277 (J;US)

E

EARTH ATMOSPHERE
See also IONOSPHERE
Global energy and the greenhouse issue, 15:36710 (J;GB)
Incorporation of an explosive cloud rise code into ARAC's [Atmospheric Release Advisory Capability] ADPIC transport and diffusion model, 15:37588 (R;US)
Perturbation growth by thermal blooming in turbulence, 15:37742 (J;US)
Stimulated thermal Rayleigh scattering threshold induced by velocity turbulence, 15:37706 (J;US)
EARTH PLANET
A qualitative architecture for understanding policy responses to global change, 15:37019 (BA;US)

EARTHQUAKES
Smithsonian Institution: Bulletin of the Global Volcanism Network. Monthly report, 15:37689 (R;US)
EBD FILMS
See ENERGY BEAM DEPOSITION FILMS
EBFA
See ELECTRON BEAM FUSION ACCELERATOR
EBIC
See SCANNING ELECTRON MICROSCOPY
EBR-2 REACTOR
An overview of the EBR-II PRA [Probabilistic Risk Assessment], 15:36956 (R;US)
Design of a reactor inlet temperature controller for EBR-2 using state feedback, 15:36937 (R;US)
Designing an AI-environment prototype for the automatic startup of EBR-II [Experimental Breeder Reactor-II], 15:36941 (R;US)
EBR-II in-vessel natural circulation experiments on hot and cold pool stratification, 15:36963 (R;US)
Frequency response testing at Experimental Breeder Reactor II using discrete-level periodic signals, 15:36923 (R;US)
Real-time LMR control parameter generation using advanced adaptive synthesis, 15:36917 (R;US)
Steady-state irradiation testing of U-Pu-Zr fuel to >18% burnup, 15:36924 (R;US)
ECONOMETRICS
Econometrics, 15:37010 (R;FR;In French)
EDTA
Enhanced flue gas denitrification using ferrous EDTA and a polyphenolic compound having combined antioxidant and reducing properties, 15:36706 (R;US)
Use of ferrous chelates for NO_x control in aqueous scrubbers, 15:36707 (R;US)
EDUCATIONAL FACILITIES
DOE/NE University Program in robotics for advanced reactors: Program plan, FY 1990–FY 1994, 15:37375 (R;US)
EDUCATIONAL TOOLS
Distance learning conference proceedings, 15:38343 (R;US)
EFFLUENTS (GASEOUS)
See GASEOUS WASTES
EFFUSION
See DIFFUSION
EHF RADIATION
See MICROWAVE RADIATION
EINSTEIN-DE SITTER MODEL
See COSMOLOGICAL MODELS
EINSTEINIUM ISOTOPES
Heavy actinide production from the interactions of ^{40}Ar with ^{248}Cm and a comparison with the ^{44}Ca-^{248}Cm system, 15:37887 (J;US)
EL SALVADOR
Results of investigations at the Ahuachapan geothermal field, El Salvador: Part 1, Well logging and brine geochemistry, 15:36861 (R;US)
ELECTRIC BATTERIES
See also METAL-NONMETAL BATTERIES
Composite polyphase electrochemical cell components, 15:37003 (BA;US)
ELECTRIC CABLES
Ampacity test of 28 AWG ribbon cables, 15:37404 (R;US)
ELECTRIC CONDUCTIVITY
Viscosity, electrical conductivity, and cesium volatility of ORNL [Oak Ridge National Laboratory] vitrified soils with limestone and sodium additives, 15:36785 (R;US)
ELECTRIC DISCHARGES
See also FLASHOVER
Electron swarms in two phase plasmas, 15:38084 (BA;US)
Including electron-electron collisions in Monte Carlo simulations of swarms in partially ionized plasmas, 15:38298 (BA;US)
ELECTRIC FIELDS
The design of a 400 kV parallel plate electrostatic analyzer for use with the 2 MeV heavy ion beam probe, 15:38082 (BA;US)
ELECTRIC POTENTIAL
Thermal effects on the Josephson series-array voltage standard, 15:37412 (R;US)
ELECTRIC POWER
Annual outlook for US electric power 1990: Projections through 2010, 15:37035 (R;US)
Electric Power Monthly, March 1990, 15:37034 (R;US)
Utilization of off-peak electric power to improve cycle efficiency during peak demand periods, 15:36887 (R;US)
ELECTRIC POWER INDUSTRY
The effects of land disposal restrictions for certain hazardous-waste contaminated soil and debris on energy-related industries: Final report, 15:37149 (R;US)
ELECTRIC POWER SYSTEMS
See POWER SYSTEMS
ELECTRIC RESISTIVITY
See ELECTRIC CONDUCTIVITY
ELECTRIC UTILITIES
Commercial cool storage laboratory test procedure, 15:37001 (R;US)
Electric trade in the United States, 1986, 15:37036 (R;US)
Integrated resource planning for electric and gas utilities, 15:37033 (R;US)
Key issues in electric utility integrated resource planning: Findings from a nationwide study, 15:37038 (R;US)
The market penetration of energy-efficiency programs, 15:37037 (R;US)
ELECTRIC-POWERED VEHICLES
Engineering evaluation testing of the Soleq Dual Battery Van, 15:37157 (R;US)
ELECTRICAL CONDUCTIVITY
See ELECTRIC CONDUCTIVITY
ELECTRICAL EQUIPMENT
See also ANTENNAS
ELECTRICAL INSULATORS
TRANSFORMERS
Analysis of the poloidal field system leads in the IGNITEX experiment, 15:38116 (RA;US)
Commissioning tests and simulation result comparison in RFX AC/DC converters, 15:38231 (RA;US)
Designing equipment for use in gamma radiation environments, 15:36759 (R;US)
ELECTRICAL INSULATORS
Probing the Coulomb gap in insulating *n*-type CdSe, 15:37316 (J;US)
ELECTRICAL RESISTANCE
See ELECTRIC CONDUCTIVITY
ELECTRICAL RESISTIVITY
See ELECTRIC CONDUCTIVITY
ELECTRODES
See also CATHODES
GRIDS
Electron swarms in two phase plasmas, 15:38084 (BA;US)
Initial tests on in situ vitrification using electrode feeding techniques, 15:36787 (R;US)
Thermal instability in current-carrying plasmas, 15:38083 (BA;US)
ELECTROMAGNETIC FIELDS
Immunological and biochemical effects of 60-Hz electric and magnetic fields in humans: Phase 3, Quarterly report No. 9, October 1–December 31, 1987, 15:37684 (R;US)
Immunological and biochemical effects of 60-Hz electric and magnetic fields in humans: Phase 3: Quarterly report No. 6, January 1–March 31, 1987, 15:37683 (R;US)
Magnetic fields and behavior: Annual performance report, 1989–1990, 15:37685 (R;US)
[Low frequency electromagnetic fields and public health]: Foreign trip report, April 30–May 8, 1988, 15:37686 (R;US)
ELECTROMAGNETIC FORM FACTORS
Measurements of magnetic form factor of nucleon and few nucleon system, 15:37827 (RA;JP;In Japanese)
ELECTROMAGNETIC PULSES
Short RF pulse propagation in a traveling wave structure, 15:37480 (RA;US)
ELECTROMAGNETIC RADIATION
See also COHERENT RADIATION
ELECTROMAGNETIC PULSES

GAMMA RADIATION
LASER RADIATION
MICROWAVE RADIATION
VISIBLE RADIATION
X RADIATION

Modelling of the vapor shield mechanism during high heat flux ablation of surfaces, 15:38277 (BA;US)

ELECTROMAGNETIC WAVES
See ELECTROMAGNETIC RADIATION

ELECTRON ACCEPTOR
See ELECTRONS

ELECTRON BEAM FUSION ACCELERATOR
Fast rise-time magnetic field coil study, 15:38286 (BA;US)
Initial tests of a 10 MW, 35 GHz phase-locked gyrotron oscillator driven by a pulseline accelerator, 15:38279 (BA;US)
Ion channel transport systems for high current electron beam accelerators, 15:38281 (BA;US)
Studies of injected particle trajectories in the beat wave accelerator, 15:38056 (BA;US)

ELECTRON BEAM INDUCED CURRENT
See SCANNING ELECTRON MICROSCOPY

ELECTRON BEAMS
Analysis and modelling of improved accelerating cavities for the Recirculating Linear Accelerator (RLA), 15:37458 (R;US)
Characterization of the time-evolution of a microsecond electron beam diode with anode effects, 15:38072 (BA;US)
Ion-channel laser, 15:37422 (J;US)
Prospect of electron polarization at TRISTAN, 15:37508 (RA;JP)
Temporal characterization of the 19-MV, 700-kA HERMES III electron beam, 15:37445 (R;US)
Test apparatus of GaAs spin polarized electron source at Nagoya University, 15:37487 (RA;JP)
The coaxial cavity locked HPM tube and external HPM feedback stabilization, 15:38290 (BA;US)
Transport and acceleration of low-emittance electron beams, 15:37451 (RA;US)

ELECTRON COLLISIONS
See also ELECTRON-ION COLLISIONS
Application of parallel computing to the Monte Carlo simulation of electron scattering in solids: A rapid method for profile deconvolution, 15:37953 (R;US)
[Workshop on artificially ionized layers in the atmosphere]: Foreign trip report, October 5–14, 1989, 15:37568 (R;US)

ELECTRON CYCLOTRON MASERS
See MICROWAVE AMPLIFIERS

ELECTRON DENSITY
Error analysis of a new asymmetric Abel-inversion method, 15:38032 (R;US)
Radiofrequency ionization of helium with turbulent flow-measurements versus theory, 15:38289 (BA;US)

ELECTRON DONOR
See ELECTRONS

ELECTRON GAS
Fermi liquid character in the photoemission/inverse photoemission spectra of highly correlated electron systems, 15:37965 (J;US)
Sign problem in the numerical simulation of many-electron systems, 15:38006 (J;US)

ELECTRON MICROSCOPES
Spin-polarized scanning tunneling microscope: Concept, design, and preliminary results from a prototype operated in air, 15:37423 (J;US)

ELECTRON MULTIPLIER DETECTORS
Gated microchannel plate detector (Engineering Materials), 15:37512 (E;US)

ELECTRON REACTIONS
Analysis of pion scattering to stretched states in ^{60}Ni and other nuclei using Woods-Saxon wave functions, 15:37854 (J;US)
Electrodisintegration of deuteron at threshold, 15:37842 (RA;JP)
Measurements of magnetic form factor of nucleon and few nucleon system, 15:37827 (RA;JP;In Japanese)

ELECTRON SOURCES
Electron sources, 15:37712 (R;FR)

ELECTRON-DEUTERON INTERACTIONS
The polarization observables and the short range deuteron structure, 15:37841 (R;FR;In French)

ELECTRON-ION COLLISIONS
Electron-impact ionization data for the nickel isonuclear sequence, 15:37715 (R;US)

ELECTRON-POSITRON INTERACTIONS
A search for long-lived low mass states coupling to e^+e^-, 15:37825 (R;US)
An inclusive and exclusive algorithm for QED evolution, 15:37798 (J;US)
Exclusive and inclusive decays of B mesons into D_s mesons, 15:37781 (J;US)
Heavy flavor resonances and QED radiative corrections, 15:37799 (J;US)
Neutrino counting at e^+e^- colliders, 15:37800 (J;US)
Noodles and stars allow a precise and efficient calculation of the Z-line shape and the polarization asymmetry, 15:37796 (J;US)
Production and decay of the τ lepton, 15:37777 (R;DE;In German)
Radiative corrections at SLC and LEP, 15:37797 (J;US)
Study of the all neutral final state of $f_2(1270)$ produced in two-photon collisions as a background to radiative neutrino counting on the Z^0 resonance, 15:37801 (J;US)
Study of the muonic channel of $e^+e^- \rightarrow \mu^+\mu^-$ (γ) for the DELPHI experiment: radiative corrections and performance of trigger and reconstruction systems, 15:37776 (R;FR;In French)
The measurability, by means of the DELPHI detector, of the Z^0 mass and width from the $e^+e^- \rightarrow \mu^+\mu^-\gamma_1 \ldots \gamma_n$ (muons) reaction, 15:37774 (R;FR;In French)
The renormalization group improved YFS [Yennie-Frautschi-Suura] method in QED, 15:37795 (J;US)

ELECTRONIC DATA PROCESSING
See DATA PROCESSING

ELECTRONIC EQUIPMENT
See also AMPLIFIERS
MICROWAVE EQUIPMENT
OSCILLATORS
POWER SUPPLIES
Designing equipment for use in gamma radiation environments, 15:36759 (R;US)
Simulation fidelity in reactor irradiation of electronics, 15:37407 (R;US)

ELECTRONS
See also RUNAWAY ELECTRONS
TRAPPED ELECTRONS
The electron energy distribution function of noble gases with flow, 15:38061 (BA;US)
Towards a bosonization of quantum electrodynamics, 15:37815 (J;US)

ELECTROSTATIC ANALYZERS
Magnetic field effects in electrostatic analyzers used for heavy ion beam probe measurements, 15:38081 (BA;US)
The design of a 400 kV parallel plate electrostatic analyzer for use with the 2 MeV heavy ion beam probe, 15:38082 (BA;US)

ELECTROSTATIC PRECIPITATORS
Flue gas cleanup technology utilizing energetic electrons: Final report, May 6, 1986–March 5, 1989, 15:36899 (R;US)

ELECTROSTATIC WAVES
See PLASMA WAVES

ELEMENTARY PARTICLES
See also CHARM PARTICLES
HADRONS
LEPTONS
Research in elementary particle physics: Technical progress report, June 1, 1989–May 31, 1990, 15:37753 (R;US)
Topics in gauge theories and the unification of elementary particle interactions: Progress report, March 1, 1990–February 28, 1990, 15:37754 (R;US)

ELEMENTS
See also METALS
Trace elements concentrations at San Juan metropolitan area and at El Yunque peak, 15:37589 (BA;US)

EMERGENCIES
See ACCIDENTS

EMERGENCY PLANS
Evaluating protective actions for chemical agent emergencies, 15:37560 (R;US)
Objectives, specification and elaboration of technical scenarios for emergency drills involving a French PWR, 15:36908 (R;FR)
Reentry planning: The technical basis for offsite recovery following warfare agent contamination, 15:37561 (R;US)

EMERGENCY PROVISIONS
See EMERGENCY PLANS

EMISSION COMPUTED TOMOGRAPHY
See also POSITRON COMPUTED TOMOGRAPHY
SPECT [single photon emission computed tomography] assay of radiolabeled monoclonal antibodies: Progress report, September 1989–April 1990, 15:37645 (R;US)

EMP
See ELECTROMAGNETIC PULSES

EMPLOYEES
See PERSONNEL

ENDONUCLEASES
Incision of damaged versus nondamaged DNA by the Escherichia coli UvrABC proteins, 15:37639 (J;US)

ENERGY ANALYSIS
Adaptation and experimentation of management and physical economy models to the problems of the regional energy planning, 15:37007 (R;FR;In French)
Benchmarking of energy time series, 15:37008 (R;US)

ENERGY BEAM DEPOSITION FILMS
Laser conditioning of optical thin films, 15:38272 (R;US)

ENERGY CONSERVATION
Evaluation
An economic evaluation of efficiency improvements in residential water heating equipment, 15:37083 (RA;US)
An evaluation of carpooling projects at two Missouri rideshare programs, 15:37077 (RA;US)
An evaluation of central Maine Power Company's pilot water heater cycling program, 15:37072 (RA;US)
An evaluation of the Bonneville Power Administration wood heat displacement program, 15:37048 (RA;US)
An investigation of commercial and industrial utility demand-side management program impacts, 15:37100 (RA;US)
Analysis of weatherization measures in low-income mobile homes, 15:37060 (RA;US)
Are high-participation residential conservation programs still feasible? The Santa Monica RCS model revisited, 15:37098 (RA;US)
Assessment of state needs for information and technical assistance in planning and evaluating residential energy conservation programs, 15:37099 (RA;US)
Attrition bias in fuel savings evaluations of low-income energy conservation programs, 15:37078 (RA;US)
Case study analysis of the institutional buildings program in Washington State, 15:37090 (RA;US)
Comparative analysis of the effect of incentives on weatherization programs, 15:37049 (RA;US)
Comparative analysis of three commercial sector financing mechanisms, 15:37055 (RA;US)
Comparison of alternative segmentation approaches for residential customers, 15:37110 (RA;US)
Comprehensive evaluation: A commercial sector example, 15:37086 (RA;US)
Correction for self-selection bias: Theory and application, 15:37082 (RA;US)
Cost-effectiveness enlightenment: Which is the right test?, 15:37094 (RA;US)
Danish programs for efficient use of energy, 15:37068 (RA;US)
Demand-side management and economic development: A practical discussion, 15:37052 (RA;US)
Design assistance for new commercial buildings, 15:37101 (RA;US)
Durability of fuel savings for single-family households: Ohio Home Weatherization Assistance Program (HWAP) program years 1985 and 1986, 15:37058 (RA;US)
Electricity savings from a small C and I lighting retrofit program: Approaches and results, 15:37063 (RA;US)
Energy program evaluation using P/G% decision-aiding software, 15:37104 (RA;US)
Energy use and consumer dissimilarity in multifamily residential conservation, 15:37079 (RA;US)
Estimation of the incremental cost of constructing super good cents homes: Methodology and results, 15:37112 (RA;US)
Evaluating community energy management strategies using the options model, 15:37103 (RA;US)
Evaluating customer willingness to pay to avoid electric outages, 15:37066 (RA;US)
Evaluating energy and non-energy impacts of energy conservation programs: A supply curve framework of analysis, 15:37102 (RA;US)
Evaluating energy-efficiency programs: A personal view of progress and potential, 15:37115 (RA;US)
Evaluating the cost-effectiveness of a commercial and industrial conservation program, 15:37095 (RA;US)
Evaluating utility direct load control programs: The duty cycle approach, 15:37071 (RA;US)
Evaluation of Bonneville's commercial audit program, 15:37087 (RA;US)
Evaluation of California's Energy efficient building standards: The residential building monitoring project, 15:37111 (RA;US)
Evaluation of DOE's [Department of Energy] resource-leveraging partnerships for low-income weatherization, 15:37056 (RA;US)
Evaluation of a residential appliance rebate program using billing record analyses, 15:37085 (RA;US)
Evaluation of the Utah Institutional Conservation Program: Preliminary results, 15:37089 (RA;US)
Factors affecting response rates in commercial and industrial customer surveys, 15:37106 (RA;US)
First year evaluation of the NEES cooperative interruptible service program, 15:37065 (RA;US)
High efficiency fluorescent lighting program: An experiment with marketing techniques to reach commercial and small industrial customers, 15:37061 (RA;US)
Impact evaluation of project HELP: Direct weatherization for low-income, elderly, and handicapped customers, 15:37057 (RA;US)
Integrating process and impact evaluation findings to modify the oil help rebate measure list, 15:37107 (RA;US)
Integration of process evaluation and program design, 15:37064 (RA;US)
Limited-income elderly: Implications for program design and implementation, 15:37109 (RA;US)
Making conservation profitable: Issues for regulation and evaluation, 15:37114 (RA;US)
Marketing energy of conservation in an environment of abundance, 15:37051 (RA;US)
Measuring the value of customer service at Seattle City Light, 15:37074 (RA;US)
New Jersey conservation analysis project: Energy savings from residential programs, 15:37069 (RA;US)
PG and E's value of residential services research, 15:37075 (RA;US)
Persistence of energy savings in Seattle City Light's residential weatherization program, 15:37091 (RA;US)
Program evaluation of the New York State Energy Efficient Appliance Rebate Demonstration Program: The free rider factor, 15:37081 (RA;US)
Promoting the commercialization of energy innovations: An evaluation of the energy-related inventions program, 15:37053 (RA;US)
Residential direct load control: Comfort effects and predictors of load savings, 15:37070 (RA;US)
Residential energy efficiency and fuel choice, 15:37113 (RA;US)
Service quality study: Wisconsin Power and Light Company, 15:37073 (RA;US)
Serving vital needs: An evaluation of the energy savings for nonprofits program, 15:37088 (RA;US)
Shooting with a moving camera: Trends in commercial buildings energy consumption, 1979 through 1986, 15:37097 (RA;US)
Short-term energy evaluation program (STEEP) of the Illinois Weatherization program, 15:37059 (RA;US)

Some estimates of free rider proportions in demand-side management programs, 15:37080 (RA;US)
Testing the effectiveness of a residential rebate program by tracking sales of appliances inside and outside the utility's territory: The case of Wisconsin Electric's 1988 Smart Money Program, 15:37084 (RA;US)
The Michigan low-income weatherization energy education and incentives program, 15:37050 (RA;US)
The industrial lighting incentive program: Process and impact evaluation, 15:37062 (RA;US)
The persistence of energy savings over time: Two and three years after participation in a retrofit program, 15:37092 (RA;US)
The promotion of residential energy-efficient lighting: Results of Massachusetts Electric Company's Enterprise Zone Plan, 15:37105 (RA;US)
Third party contracting versus customer programs for commercial/industrial customers, 15:37054 (RA;US)
Toward a common method of reporting and comparing results from evaluations of residential conservation programs, 15:37093 (RA;US)
Using commercials to sell DSM programs: A measurement of customer response, 15:37076 (RA;US)
Utilization of residential energy conservation program evaluation in least-cost utility planning, 15:37067 (RA;US)
Variability in commercial markets and implications for program transferability, 15:37096 (RA;US)
Views and opinions on energy programs and services: Results of focus group interviews with low-income hispanics, blacks, and senior citizens, 15:37108 (RA;US)

Industry
Ten years of pilot technical applications of energy conservation in the industry, 15:37141 (R;FR;In French)

Measuring Methods
Assessment of the energy conservation potential of active (variable thermal resistance and switchable absorptance) building thermal insulation systems, 15:37124 (R;US)

Performance
Measurement of energy performance in a small bank building, 15:37121 (R;US)

Planning
The federal government should do more to improve US energy efficiency, 15:37030 (R;US)

Regional Analysis
Follow-up of the regional energy conservation politics. Methods and illustration with the case of Charente-Poitou, 15:37006 (R;FR;In French)

Research Programs
PIRSEM: 1987 operations review. Volume 1, 15:37045 (R;FR;In French)
PIRSEM: 1987 operations review. Volume 2, 15:37046 (R;FR;In French)
PIRSEM: 1987 operations review. Volume 3, 15:37020 (R;FR;In French)

Technology Assessment
Balancing the roles for conservation, coal, nuclear, and other energy systems, 15:37026 (R;US)

Technology Transfer
Building Thermal Envelope Systems and Materials (BTESM) and research utilization/technology transfer progress report for DOE Office of Buildings and Community Systems: Monthly progress report, 15:37122 (R;US)

ENERGY CONSUMPTION
Energy, development and environment: planetary stakes in the 21st century, 15:37028 (J;FR;In French)
Forces shaping the energy required to support western hemisphere development, 15:37027 (R;US)
Measured space-cooling electricity savings from standard energy conservation measures, radiant barriers, and high-efficiency window air conditioners, 15:37118 (R;US)

ENERGY CONVERSION
See also SOLAR ENERGY CONVERSION
Solar energy and hydrogen - for qualitative growth, 15:37005 (R;DE;In German)
Study of an advanced D-T tokamak fusion reactor with compact fusion advanced rankine (CFAR) cycle, 15:38224 (RA;US)

ENERGY DEMAND
Balancing the roles for conservation, coal, nuclear, and other energy systems, 15:37026 (R;US)

ENERGY EFFICIENCY
Energy efficiency demonstration scheme: June 1988 review of ETSU portfolio, 15:37047 (R;GB)

ENERGY FACILITIES
Impact of accelerated sea level rise on coastal energy facilities, U.S.A., 15:37625 (BA;US)

ENERGY INFORMATION ADMINISTRATION
EIA Publications Directory, 1977–1989, 15:37004 (R;US)

ENERGY LEVELS
See also HIGH SPIN STATES
YRAST STATES
Accurate alpha sticking fractions from improved calculations relevant for muon catalyzed fusion: Final report, 15:37709 (R;US)
Relativistic effects on the $s \rightarrow d$ promotion energy and spin-polarization energy of the transition metals, 15:37724 (J;US)

ENERGY SOURCES
See also FOSSIL FUELS
NUCLEAR FUELS
RENEWABLE ENERGY SOURCES
A qualitative architecture for understanding policy responses to global change, 15:37019 (BA;US)
Basic energy sciences: Summary of accomplishments, 15:37022 (R;US)

ENERGY STORAGE
See also MAGNETIC ENERGY STORAGE
Utilization of off-peak electric power to improve cycle efficiency during peak demand periods, 15:36887 (R;US)
Vertical stability requirements for ARIES-1 reactor, 15:38145 (RA;US)

ENERGY STORAGE SYSTEMS
Energy storage and distribution program summary: Volume 2, Research summaries, Fiscal year 1989, 15:37021 (R;US)
The HNEI/Kahua wind energy storage test facility, 15:36883 (BA;US)

ENERGY-LEVEL SCHEMES
See ENERGY LEVELS

ENGINEERING PERSONNEL
Distance learning conference proceedings, 15:38343 (R;US)
Training scientists and engineers for the year 2000: Testimony before the Subcommittee on Science, Technology, and Space , Committee on Commerce, Science, and Transportation, United States Senate, 15:37154 (R;US)

ENHANCED RECOVERY
National Institute for Petroleum and Energy Research monthly progress report for May 1990, 15:36726 (R;US)

ENRICHMENT PLANTS (CENTRIFUGE)
See CENTRIFUGE ENRICHMENT PLANTS

ENTRY CONTROL SYSTEMS
A performance evaluation of biometric identification devices, 15:38346 (R;US)
Selecting appropriate test targets for portal weapons detection, 15:37380 (R;US)

ENVELOPE HOUSES
See DOUBLE ENVELOPE BUILDINGS

ENVIRONMENT
Annual radiological environmental monitoring report, Watts Bar Nuclear Plant, 1989, 15:37581 (R;US)
Annual radiological environmental operating report, Browns Ferry Nuclear Plant, 1989, 15:37582 (R;US)
Annual radiological environmental operating report, Sequoyah Nuclear Plant, 1989, 15:37583 (R;US)
NRC TLD [thermoluminescent dosimeter] Direct Radiation Monitoring Network: Progress report, January–March 1990: Volume 10, No. 1, 15:36973 (R;US)
Naval Petroleum Reserve No. 3, Naval Oil Shale Reserves Nos. 1, 2, 3: Site environmental report, CY 1989, 15:37564 (R;US)
Tiger Team Assessment of the Lawrence Livermore National Laboratory, 15:36798 (R;US)

ENVIRONMENTAL EXPOSURE PATHWAY
Review of the chronic exposure pathways models in MACCS [MELCOR Accident Consequence Code System] and several other well-known probabilistic risk assessment models, 15:37599 (R;US)
Uncertainty in exposure and health-risk assessment: An integrated approach, 15:37623 (R;US)
ENVIRONMENTAL MATERIALS
Radioactivity survey data in Japan, part 1: Environmental materials, 15:37598 (R;JP)
Radioactivity survey data in Japan, part 2: Dietary materials, 15:37660 (R;JP)
Radioactivity survey data in Japan, part 2: Dietary materials, 15:37661 (R;JP)
ENVIRONMENTAL POLICY
Environmental regulatory update table, April 1990, 15:37014 (R;US)
Environmental regulatory update table, March 1990, 15:37013 (R;US)
Environmental regulatory update table, May 1990, 15:37015 (R;US)
Naval Petroleum Reserve No. 3, Naval Oil Shale Reserves Nos. 1, 2, 3: Site environmental report, CY 1989, 15:37564 (R;US)
EPITHERMAL NEUTRONS
An accelerator neutron source for BNCT [Boron Neutron Capture Therapy]: Progress report, 15 July 1989–15 March 1990, 15:37644 (R;US)
EPOXIDES
Evolution of structure and viscoelasticity in diethanolamine-cured epoxy, 15:37294 (R;US)
EPOXY COMPOUNDS
See EPOXIDES
EPSILON RESONANCES
See MESONS
EQUIPMENT
See also ELECTRICAL EQUIPMENT
ELECTRONIC EQUIPMENT
OPTICAL EQUIPMENT
POLLUTION CONTROL EQUIPMENT
THERMAL ENERGY STORAGE EQUIPMENT
Nondestructive evaluation research progress in 1989: Proceedings from the tenth annual EPRI NDE information meeting, 15:36934 (R;US)
EQUIPMENT PROTECTION DEVICES
Hazard rate for a two-channel protective system subject to a high demand rate, 15:37385 (BA;US)
ERBIUM OXIDES
Two- and three-dimensional magnetic order of the rare-earth ions in $RBa_2Cu_4O_8$, 15:37277 (J;US)
ESCHERICHIA COLI
Incision of damaged versus nondamaged DNA by the Escherichia coli UvrABC proteins, 15:37639 (J;US)
ESTERS
Mechanism and applicability of hydrolysis of peptides and proteins utilizing Pt(II) complexes, 15:37521 (R;US)
ESTUARIES
Transport processes of suspended matter derived from time series in a tidal estuary, 15:37597 (R;DE)
ESTUARINE ECOSYSTEMS
See AQUATIC ECOSYSTEMS
ETA MESONS
Leptonic CP violation in leptoquark models, 15:37794 (R;CA)
ETA-549
See ETA MESONS
ETA-700 RESONANCES
See MESONS
ETHANOL
Scale-up and performance of an immobilized cell reactor separator for the production of ethanol from whey lactose, 15:36821 (R;US)
ETHANOL FUELS
Alternative transportation fuels: A tax and energy perspective, 15:36824 (BA;US)
ETHOCEL
See CELLULOSE
ETHYL ALCOHOL
See ETHANOL
ETHYLENE POLYMERS
See POLYETHYLENES
ETHYLENEDIAMINETETRAACETIC ACID
See EDTA
EXCHANGE (HEAT)
See HEAT TRANSFER
EXCIMER LASERS
See also KRYPTON FLUORIDE LASERS
Process margins for laser planarization of 1 to 5 μm gold films, 15:37958 (BA;US)
EXCURSIONS
Taking into account a reactivity accident in research reactors design, 15:36951 (R;FR;In French)
EXHAUST GASES
Emission and biological activity of N-containing polycyclic aromatic compound as exhaust of Diesel engines, 15:37158 (R;DE;In German)
EXPERIMENTAL BREEDER REACTOR-2
See EBR-2 REACTOR
EXPERIMENTAL FACILITIES (ACCELERATOR)
See ACCELERATOR FACILITIES
EXPLOSIONS
See also CHEMICAL EXPLOSIONS
EXPAC [EXPlosion Analysis Code] user's manual: A computer code for analyzing explosion-induced flow and material transport in nuclear facilities, 15:36802 (R;US)
Spherical element bulking mechanisms for modeling blasting induced rock motion, 15:36754 (R;US)
Two-dimensional multiburst calculations with the SHALE code, 15:37551 (R;US)
EXTENSIVE AIR SHOWERS
The experimental search for point sources above 1 TeV, 15:37699 (J;US)
EXTENSOMETERS
Technique for tensile creep testing of ceramics, 15:37253 (J;US)
EXTREMELY HIGH FREQUENCY RADIATION
See MICROWAVE RADIATION

F

F CODES
On the implementation of complex many-to-many relations in focus, 15:38321 (R;US)
F-1260 RESONANCES
See F2-1270 MESONS
F-1540 RESONANCES
See MESONS
F1-1285 MESONS
New DM2 results on $D/f_1(1285)$ and $\iota/\eta(1440)$, 15:37766 (R;FR)
F2-1270 MESONS
Study of the all neutral final state of $f_2(1270)$ produced in two-photon collisions as a background to radiative neutrino counting on the Z^0 resonance, 15:37801 (J;US)
FABRICATION
See also SINTERING
Laser ultrasonic measurements on ceramic materials with rough surfaces, 15:37232 (R;US)
FACE CENTERED CUBIC
See FCC LATTICES
FACILITIES (ACCELERATOR)
See ACCELERATOR FACILITIES
FACILITIES (EDUCATIONAL)
See EDUCATIONAL FACILITIES
FACILITIES (ENERGY)
See ENERGY FACILITIES
FACILITIES (NUCLEAR)
See NUCLEAR FACILITIES
FACILITIES (STORAGE)
See STORAGE FACILITIES

FACILITIES (TEST)
See TEST FACILITIES
FALLOUT
Off-Site Radiation Exposure Review Project: Phase 2 soils program: Revision, 15:37596 (R;US)
FALLOUT PARTICULATES
See FALLOUT
PARTICLES
FAST FLUX TEST FACILITY REACTOR
See FFTF REACTOR
FAST NEUTRONS
Clinical neutron dosimetry: Part 1, Determination of absorbed dose in a patient treated by external beams of fast neutrons, 15:37938 (R;US)
FAST REACTORS
See also FFTF REACTOR
IFR REACTOR
Advances on the analysis of fast reactor core and coolant circuit structures, 15:36996 (BA;US)
FASTENERS
Failure of Inconel X-750 bolts of internals of the CHOOZ-A nuclear power plant, 15:36910 (R;FR)
FAURE CYCLOTRON
See NAC CYCLOTRON
FCC LATTICES
Structure-energy correlation for grain boundaries in F.C.C. metals: I. boundaries on the (111) and (100) planes, 15:37721 (J;US)
FEDERAL REGION IV
Sixth annual Gatlinburg acid rain conference: Proceedings, 15:37679 (R;US)
FEDERAL REGION X
Multicomponent case weights for the 1985 resample of the 1983 Pacific Northwest residential energy survey, 15:37126 (R;US)
The Residential Building Characteristics On-Site Inspection: Summary report, 15:37127 (R;US)
FERMENTATION ALCOHOL
See ETHANOL
FERMIUM ISOTOPES
Heavy actinide production from the interactions of ^{40}Ar with ^{248}Cm and a comparison with the ^{44}Ca-^{248}Cm system, 15:37887 (J;US)
FERRIC COMPOUNDS
See IRON COMPOUNDS
FERROMAGNETIC MATERIALS
The repetitive high energy pulsed power module, 15:37411 (R;US)
FERROUS COMPOUNDS
See IRON COMPOUNDS
FERTILIZERS
Root and foliar nutrient concentrations in loblolly pine: Effects of season, site, and fertilization, 15:37609 (J;US)
FFTF REACTOR
Analysis of Beyond Design Basis Events for the Fast Flux Test Facility UO_2 core, 15:36989 (R;US)
Fuel aspects of Beyond Design Basis Event analyses for the Fast Flux Test Facility, 15:36928 (R;US)
FIELD EFFECT TRANSISTORS
Growth studies of pseudomorphic GaAs/InGaAs/AlGaAs modulation-doped field-effect transistor structures, 15:37311 (J;US)
FIELD-REVERSED THETA PINCH DEVICES
Confinement dynamics in the ZT-40M RFP, 15:38063 (BA;US)
Design and initial operation of the Madison Symmetric Torus, 15:38284 (BA;US)
Magnetic flux generation and sawteeth in the MST reversed-field pinch, 15:38285 (BA;US)
FIELDS (ELECTRIC)
See ELECTRIC FIELDS
FIELDS (ELECTROMAGNETIC)
See ELECTROMAGNETIC FIELDS
FIELDS (MAGNETIC)
See MAGNETIC FIELDS
FILLERS
Thermal expansion of beta-eucryptite filled bismaleimide and glass/bismaleimide composites, 15:37295 (R;US)
FILMS
See also ENERGY BEAM DEPOSITION FILMS
THIN FILMS
Island growth and coarsening in thin films—conservative and nonconservative systems, 15:37969 (J;US)
FINANCIAL MANAGMENT
See PROGRAM MANAGEMENT
FIREDAMP
See METHANE
FIRES
Estimating nitrogen lost from forest floor during prescribed fires in Douglas-fir/western hemlock clearcuts, 15:37607 (J;US)
Fire protection review revisit No. 2, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio, 15:36799 (R;US)
FIRST WALL
A radiation-cooled armor tile design for the first wall of ITER (International Thermonuclear Experimental Reactor), 15:38128 (RA;US)
Impurity release disruption effects, and thermomechanical stress analysis of the first wall system for the IGNITEX experiment, 15:38130 (RA;US)
Modeling of runaway electron damage for the design of tokamak plasma facing components, 15:38148 (RA;US)
Silicon-carbide composite materials for the ARIES-I reactor study, 15:38216 (RA;US)
FISHES
Annual radiological environmental monitoring report, Watts Bar Nuclear Plant, 1989, 15:37581 (R;US)
Annual radiological environmental operating report, Browns Ferry Nuclear Plant, 1989, 15:37582 (R;US)
Annual radiological environmental operating report, Sequoyah Nuclear Plant, 1989, 15:37583 (R;US)
Biological (molecular and cellular) markers of toxicity: Semiannual technical progress report No. 3, October 1, 1989–March 31, 1990, 15:37677 (R;US)
FISSILE MATERIALS
Transactions of the criticality alarm systems workshop, 15:36801 (R;US)
FISSION FRAGMENTS
Fission fragment angular distributions following transfer reactions for $^{232}Th + ^{16}O$, 15:37884 (R;AU)
FISSIONABLE MATERIALS
See also FISSILE MATERIALS
Special nuclear material information, security classification guidance. Instruction, 15:36813 (R;US)
FISSIONABLE MATERIALS MANAGEMENT
See NUCLEAR MATERIALS MANAGEMENT
FLAMES
Hydroxyl radical concentration measurements in a turbulent flow reactor using a high temperature laser induced fluorescence probe, 15:37372 (BA;US)
FLASHOVER
Charge transport dynamics in surface flashover arcs, 15:38086 (BA;US)
FLAT MAGNETIC SPECTROMETERS
DOE/University instrumentation program grant for funding of the high field, high mass, double focusing, high resolution mass spectrometer: Final report, 15:37331 (R;US)
FLOODS
Response of woody swamp seedlings to flooding and increased water temperatures. I. Growth, biomass, and survivorship, 15:37628 (J;US)
FLOW (FLUID)
See FLUID FLOW
FLOW (HEAT)
See HEAT FLOW
FLUE GAS
Computer modeling of the chemistry of aqueous scrubber systems, 15:36900 (R;US)

Enhanced flue gas denitrification using ferrous EDTA and a polyphenolic compound having combined antioxidant and reducing properties, 15:36706 (R;US)
Flue gas cleanup technology utilizing energetic electrons: Final report, May 6, 1986–March 5, 1989, 15:36899 (R;US)
Simultaneous NO_x/SO_2 removal by the dry injection of lime-urea hydrate: Final report, 15:36897 (R;US)
Spray-dryer flue-gas-cleaning systems handbook, 15:36892 (R;US)
Theoretical approach for enhanced mass transfer effects in-duct flue gas desulfurization processes: Quarterly report No. 7, January 1, 1990–March 31, 1990, 15:36898 (R;US)
Use of ferrous chelates for NO_x control in aqueous scrubbers, 15:36707 (R;US)
User's guide for SDIS [Spray-Dryer Information System]: A personal computer code for the design and evaluation of spray-dryer flue-gas-cleaning systems, 15:36893 (R;US)

FLUENCE (NEUTRON)
See NEUTRON FLUENCE

FLUID FLOW
See also SOLIDS FLOW
TRANSITION FLOW
TWO-PHASE FLOW
Analysis of a DRACS [Direct Reactor Auxiliary Cooling System] test COMMIX validation, 15:36922 (R;US)
Relationship between permeability and diffusion-controlled trapping constant of porous media, 15:37745 (J;US)
STL [Simulation Technology Laboratory] Global Control System, technical reference, 15:37499 (R;US)
UNSAT-H Version 2.0: Unsaturated soil water and heat flow model, 15:36784 (R;US)
[Discrete kinetic theory, lattice gas dynamics and foundations of hydrodynamics]: Foreign trip report, September 17–October 2, 1988, 15:37741 (R;US)

FLUIDIZED BED
See FLUIDIZED BEDS

FLUIDIZED BEDS
Experimental and theoretical investigation of the formation and growth of ash agglomerates: Final report, 15:36693 (R;US)
Three-dimensional capacitance imaging system, 15:36712 (R;US)

FLUIDIZED-BED COMBUSTION
Second-generation pressurized fluidized bed [PFB] combustion plant: Conceptual design and optimization of a second-generation PFB combustion plant, Phase 1, Task 1: Volume 1, 15:36888 (R;US)

FLUIDIZED-BED COMBUSTORS
Predictive models for circulating fluidized bed combustors: Three dimensional code: Second technical progress report, 15:36713 (R;US)

FLUIDS
See also GASES
GEOTHERMAL FLUIDS
LIQUIDS
Fast sound in binary fluid mixtures, 15:37966 (J;US)
Multipolar contributions to optical second-harmonic generation in isotropic fluids, 15:38002 (J;US)

FLUORINATED ALIPHATIC HYDROCARBONS
See also FLUOROFORM
Selected properties of c-perfluorobutane, 15:37286 (R;US)

FLUORINATED AROMATIC HYDROCARBONS
Vibrational relaxation of highly excited SiF_4 and C_6F_5H by Ar, 15:37352 (J;US)

FLUORINE IONS
Binary-encounter electrons observed at 0° in collisions of 1–2-MeV/amu H^+, C^{6+}, N^{7+}, O^{8+}, and F^{9+} ions with H_2 and He targets, 15:37728 (J;US)

FLUOROFORM
Supercritical fluid thermodynamics for coal processing: Quarterly progress report, January 1, 1990–March 31, 1990, 15:36695 (R;US)

FOOD
Annual radiological environmental monitoring report, Watts Bar Nuclear Plant, 1989, 15:37581 (R;US)
Annual radiological environmental operating report, Browns Ferry Nuclear Plant, 1989, 15:37582 (R;US)
Annual radiological environmental operating report, Sequoyah Nuclear Plant, 1989, 15:37583 (R;US)
DOE uses transportable irradiator for demonstration and testing, 15:37662 (J;US)

FOOD CHAINS
Hanford Environmental Dose Reconstruction Project: Monthly report, 15:37579 (R;US)
Radium contamination in the environment. January 1972-July 1989 (A Bibliography from Pollution Abstracts). Report for January 1972-July 1989, 15:37620 (R;US)
Reentry planning: The technical basis for offsite recovery following warfare agent contamination, 15:37561 (R;US)
Review of the chronic exposure pathways models in MACCS [MELCOR Accident Consequence Code System] and several other well-known probabilistic risk assessment models, 15:37599 (R;US)

FOOD INDUSTRY
Membrane technology applications in the food industry: Present and future, 15:37151 (R;US)

FOOD IRRADIATION
See FOOD PROCESSING

FOOD PROCESSING
Factors affecting practical application of food irradiation: Proceedings of an advisory group meeting held in Vienna, 27 June - 1 July 1988, 15:37659 (R;XA)

FOODSTUFFS
See FOOD

FORESTS
Descriptions of research sites in the integrated forest study on effects of atmospheric deposition, 15:37678 (R;US)
Influence of reductions in deposition on the degree of acidification of soils and groundwater in forests - assessment of critical loads from the atmosphere. Final report, 15:37622 (R;DE;In German)

FOSSIL FUEL RESERVES
See FOSSIL FUELS

FOSSIL FUELS
See also COAL
OIL SHALES
PEAT
PETROLEUM
Assessing the potential environmental impacts of proposed rules affecting future electric power generation in the United States, 15:36901 (R;US)

FOSSIL-FUEL POWER PLANTS
Evaluation of radiation dose for radiological impact of airborne effluents of a coal-fired power plant, 15:37562 (R;CN;In Chinese)
Nondestructive evaluation research progress in 1989: Proceedings from the tenth annual EPRI NDE information meeting, 15:36934 (R;US)
Risk-based inspection guidelines, 15:36943 (J;US)
Second-generation pressurized fluidized bed [PFB] combustion plant: Conceptual design and optimization of a second-generation PFB combustion plant, Phase 1, Task 1: Volume 1, 15:36888 (R;US)
User's guide for SDIS [Spray-Dryer Information System]: A personal computer code for the design and evaluation of spray-dryer flue-gas-cleaning systems, 15:36893 (R;US)

FOSSILS
Dating of lithic artifacts by counting radon-produced particle tracks. Phase 1. Final report, 15:37688 (R;US)

FOUNDATIONS
Horizontal vibrations of piles in a centrifuge, 15:37398 (R;FR;In French)

FRACER-FULCO METHOD
See DISPERSION RELATIONS

FRAGMENTS (FALLOUT)
See FALLOUT

FRAGMENTS (FISSION)
See FISSION FRAGMENTS

FRAGMENTS (PARTICLES)
See PARTICLES

FRANCE
PIRSEM: 1987 operations review. Volume 1, 15:37045 (R;FR;In French)
FRANCO-GERMAN HIGH FLUX REACTOR
See GRENOBLE REACTOR
FRASCATI TOKAMAK
See FT TOKAMAK
FREE CONVECTION
See NATURAL CONVECTION
FREE ELECTRON LASERS
A compact x-ray free electron laser, 15:37447 (R;US)
High current RF accelerator for FEL applications, 15:37556 (RA;US)
Ion-channel laser, 15:37422 (J;US)
Theoretical simulations of the synchrotron instability in high gain, high power free electron lasers: Final report, 15:37460 (R;US)
Visible wavelength free electron oscillator, 15:37555 (RA;US)
Workshop on scientific and industrial applications of free electron lasers, 15:37539 (R;US)
FREONS
Cloud albedo, greenhouse effects, atmospheric chemistry, and climate change, 15:37590 (J;US)
FRESH WATER ECOSYSTEMS
See AQUATIC ECOSYSTEMS
FT TOKAMAK
A new two-stage pellet injector for FTU, 15:38198 (RA;US)
Active plasma position and current feedback control in the FTU tokamak machine, 15:38127 (RA;US)
Assembly procedures and thermal and mechanical performances during the commissioning phase of the FTU machine, 15:38124 (RA;US)
The 8 MW, 8 GHz FTU LHRH system: R and D and design status, 15:38160 (RA;US)
FTR REACTOR (RICHLAND)
See FFTF REACTOR
FUEL ASSEMBLIES
See also FUEL ELEMENT CLUSTERS
Forced-to-natural convection transition tests in parallel simulated liquid metal reactor fuel assemblies, 15:36915 (R;US)
FUEL BUNDLES
See FUEL ELEMENT CLUSTERS
FUEL CANS
Consequences of metallic fuel-cladding liquid phase attack during over-temperature transient on fuel element lifetime, 15:36919 (R;US)
Fuel/cladding compatibility in irradiated metallic fuel pins at elevated temperatures, 15:36920 (R;US)
Zircaloy cladding performance under spent fuel disposal conditions: Progress report, May 1–October 31, 1989, 15:36766 (R;US)
FUEL ELEMENT CLUSTERS
Microcomputer based program for predicting heat transfer under reactor accident conditions. Volume I: Text, 15:36913 (R;CA)
FUEL ELEMENTS
See also FUEL PINS
FUEL RODS
Advancements in the behavioral modeling of fuel elements and related structures, 15:36997 (BA;US)
Consequences of metallic fuel-cladding liquid phase attack during over-temperature transient on fuel element lifetime, 15:36919 (R;US)
FUEL OILS
Techniques for multivariate sample design, 15:36729 (R;US)
FUEL PELLETS
A new two-stage pellet injector for FTU, 15:38198 (RA;US)
Application of the results of carbon pellet modeling to the problem of plasma penetration, 15:38017 (R;US)
Characteristics of an electron-beam rocket pellet accelerator, 15:38195 (RA;US)
Development of upgraded pellet injector for JT-60, 15:38200 (RA;US)
Eight-shot pneumatic pellet injector for the Advanced Toroidal Facility, 15:38208 (RA;US)
Initial performance and characteristics of the PBX-M pellet injector, 15:38209 (RA;US)
Ion acoustic decay instabilities in laser pellet interactions, 15:38057 (BA;US)
Operation and reliability of a pneumatic hydrogen pellet injection system on the Joint European Torus, 15:38225 (RA;US)
Pellet fueling of helium-3 enclosed in Li and Be shells, 15:38199 (RA;US)
Results from recent hydrogen pellet acceleration studies with a 2-m railgun, 15:38212 (RA;US)
The CIT pellet injection system: Description and supporting research and development, 15:38197 (RA;US)
The ORNL (Oak Ridge National Laboratory) plasma fueling program, 15:38204 (RA;US)
The control system for the multiple-pellet injector on the Joint European Torus, 15:38245 (RA;US)
Tritium proof-of-principle pellet injector results, 15:38196 (RA;US)
Upgrading the JET pellet injector with a two-stage light gas gun prototype and future planning, 15:38203 (RA;US)
FUEL PENCILS
See FUEL PINS
FUEL PINS
Fuel/cladding compatibility in irradiated metallic fuel pins at elevated temperatures, 15:36920 (R;US)
Tomographic imaging of severely disrupted fuel assemblies tested in TREAT, 15:36916 (R;US)
FUEL ROD CONSOLIDATION
See FUEL RODS
FUEL RODS
Data summary report for fission product release test VI-3, 15:36944 (R;US)
FUEL SHEATHS
See FUEL CANS
FUEL SLUGS
See FUEL RODS
FUEL SLURRIES
A large amplitude oscillating combustor, 15:36715 (BA;US)
Modeling and measurements in coal-water slurry combustion for direct-fired gas turbine applications, 15:36714 (BA;US)
FUEL SUBSTITUTION
Alternative Motor Fuel Use Model: Model theory and design and user's guide, 15:37159 (R;US)
Alternative fuels program: Fiscal year 1990, Summary program plan, 15:37032 (R;US)
FUEL SUSPENSIONS
See FUEL SLURRIES
FUEL-AIR RATIO
Investigation of particulate formation during diesel spray combustion: Technical progress quarterly report, March 1–May 31, 1990, 15:37371 (R;US)
FUELS (NUCLEAR)
See NUCLEAR FUELS
FUMES
See AEROSOLS
FUNCTIONS
See also POLYNOMIALS
Estimating the parameters of a sporadically observed queue, 15:38317 (R;US)
FUNDAMENTAL PARTICLES
See ELEMENTARY PARTICLES
FUSES
Evidence of hydrodynamic processes in multimegampere copper fuses, 15:38307 (J;US)
Generic initiation train for the fuzing: Revision 1, 15:37553 (R;US)
FUSION (BONDING, NONMETALLIC)
See BONDING
FUSION (NUCLEAR)
See THERMONUCLEAR REACTIONS
FUSION ENERGY
See THERMONUCLEAR REACTORS
FUSION FUELS
See THERMONUCLEAR FUELS
FUSION REACTIONS
See HEAVY ION FUSION REACTIONS

FUSION REACTORS
See THERMONUCLEAR REACTORS
FUZES
See FUSES

G

G CODES
Automated sensitivity analysis with the Gradient Enhanced Software System (GRESS), 15:38329 (R;US)
GADOLINIUM
Determination of the valence of Pr, Gd, and Ho in $YBa_2Cu_3O_7$ by x-ray absorption spectroscopy, 15:37221 (J;US)
GADOLINIUM OXIDES
Intrinsic fast oxygen ionic conductivity in the $Gd_2(Zr_xTi_{1-x})_2O_7$ and $Y_2(Zr_xTi_{1-x})_2O_7$ pyrochlore systems, 15:37246 (BA;US)
GALLIUM ARSENIDE SOLAR CELLS
Photovoltaic concentrator module technology, 15:36835 (R;US)
Research on design and fabrication of high-efficiency solar cells, 15:37293 (R;US)
Study and realization by liquid phase epitaxy of $Ga_{1-y}Al_yAs$ photocells, 15:36831 (R;FR;In French)
GALLIUM ARSENIDES
Application of InAlAs/GaAs superlattice alloys to GaAs solar cells, 15:37296 (R;US)
Formation of $In_xGa_{1-x}As$/GaAs heteroepitaxial layers using a pulsed laser driven rapid melt-solidification process, 15:37310 (J;US)
Growth studies of pseudomorphic GaAs/InGaAs/AlGaAs modulation-doped field-effect transistor structures, 15:37311 (J;US)
Schottky barrier contacts on defect-free GaAs (110), 15:37421 (J;US)
GAMMA CAMERAS
PET imaging: An overview and instrumentation, 15:37654 (J;US)
GAMMA RADIATION
Designing equipment for use in gamma radiation environments, 15:36759 (R;US)
Quasielastic γ-ray scattering from pentadecane, 15:37336 (J;US)
The reaction of glass during gamma irradiation in a saturated tuff environment: Part 4, SRL 165, ATM-1c, and ATM-8 glasses at 1E3 R/h and O R/h, 15:36764 (R;US)
GAMMA REACTIONS
See PHOTONUCLEAR REACTIONS
GAMMA SPECTROMETERS
Improved yield of high resolution mercuric iodide gamma-ray spectrometers, 15:37517 (R;US)
The GAMMASPHERE, 15:37515 (R;US)
GAMMA SPECTROSCOPY
In-beam gamma-ray spectroscopy with crystal ball, 15:37531 (RA;JP;In Japanese)
The GAMMASPHERE, 15:37515 (R;US)
GAS COOLANTS
See GASES
GAS FURNACES
Analysis of three measures for energy efficiency of residential gas furnaces, 15:37136 (BA;US)
GAS TURBINE ENGINES
Modeling and measurements in coal-water slurry combustion for direct-fired gas turbine applications, 15:36714 (BA;US)
GAS TURBINES
Coatings for high temperature corrosion in aero and industrial gas turbines, 15:36890 (BA;US)
GAS UTILITIES
Integrated resource planning for electric and gas utilities, 15:37033 (R;US)
GASEOUS DIFFUSION PLANTS
See also PORTSMOUTH GASEOUS DIFFUSION PLANT
Safeguards training course: Nuclear material safeguards for enrichment plants: Part 4, Gas centrifuge enrichment plant: Diversion scenarios and safeguards activities, 15:36812 (R;US)
GASEOUS EFFLUENTS
See GASEOUS WASTES
GASEOUS WASTES
See also EXHAUST GASES
FLUE GAS
Sampling and monitoring of carbon-14 in gaseous effluents from nuclear facilities: Literature survey, 15:36793 (R;FI)
GASES
See also AIR
ELECTRON GAS
EXHAUST GASES
VAPORS
Electron swarms in two phase plasmas, 15:38084 (BA;US)
Nuclear-induced UV fluorescence, 15:37720 (BA;US)
Physical and chemical characteristics of topographically affected airflow in an open borehole at Yucca Mountain, Nevada, 15:36771 (R;US)
Pulsed-gas-metal-arc welding (PGMAW) of API 5LX-80 pipe: Final report, 15:37194 (R;US)
Stability of homogeneous-solid deflagration with two-phase flow in the reaction zone, 15:37390 (J;US)
GASIFICATION
Pyrolysis-gasification of biomass. Development of a fluidized bed reactor, 15:36822 (R;FR;In French)
GAUGE INVARIANCE
Theoretical physics, 15:37989 (R;FR;In French)
GAUGE TRANSFORMATIONS
See GAUGE INVARIANCE
GE SEMICONDUCTOR DETECTORS
The GAMMASPHERE, 15:37515 (R;US)
GELS
The effects of hydrolysis and additive conditions on the gel-to-ceramic conversion of sol-gel derived $PbTiO_3$, 15:37240 (R;US)
GENERATORS (PULSE)
See PULSE GENERATORS
GENERATORS (STEAM)
See STEAM GENERATORS
GENETIC MAPPING
Life Sciences Division and Center for Human Genome Studies Annual report 1989, 15:37637 (R;US)
GEOLOGIC DEPOSITS
Geochemical criteria for reservoir quality variations in chalk from the North Sea, 15:36743 (R;DK)
GEOLOGIC FRACTURES
Evaluation of a potential borehole televiewer technique for characterizing lost circulation zones, 15:36871 (R;US)
GEOTHERMAL AREAS
See GEOTHERMAL FIELDS
GEOTHERMAL ENERGY
Environmental monitoring at designed geopressured-geothermal well sites, Louisiana and Texas: Quarterly status report, April–June 1990, 15:36867 (R;US)
Results of investigations at the Ahuachapan geothermal field, El Salvador: Part 1, Well logging and brine geochemistry, 15:36861 (R;US)
The greenhouse effect and acid rain: A tutorial, 15:37580 (R;US)
GEOTHERMAL FIELDS
See also MOMOTOMBO GEOTHERMAL FIELD
SALTON SEA GEOTHERMAL FIELD
The geopressured-geothermal resource: Transition to commercialization, 15:36866 (R;US)
GEOTHERMAL FLUIDS
A geochemical study of the fluids in several wells: The Momotombo geothermal field, 15:36865 (R;FR;In French)
Hydrogeochemical investigations in support of well logging operations at the Zunil geothermal field, Guatemala, 15:36862 (R;US)
The "Art" of in situ fluid sampling and the remarkable compositional variations in the wellbore fluid of VC-2B, Valles Caldera, New Mexico, 15:36864 (R;US)
GEOTHERMAL POWER PLANTS
Advanced binary geothermal power plants: Limits of performance, 15:36868 (R;US)
GEOTHERMAL REGIONS
See GEOTHERMAL FIELDS

GEOTHERMAL RESOURCES
UCSD geothermal chemistry program: Annual progress report, FY 1989, 15:36874 (R;US)

GEOTHERMAL WELLS
Development and field testing of the high-temperature borehole televiewer, 15:37536 (R;US)
Environmental monitoring at designed geopressured-geothermal well sites, Louisiana and Texas: Quarterly status report, April–June 1990, 15:36867 (R;US)
Evaluation of a potential borehole televiewer technique for characterizing lost circulation zones, 15:36871 (R;US)
Results of investigations at the Ahuachapan geothermal field, El Salvador: Part 1, Well logging and brine geochemistry, 15:36861 (R;US)
UCSD geothermal chemistry program: Annual progress report, FY 1989, 15:36874 (R;US)

GERMANIUM DETECTORS
See GE SEMICONDUCTOR DETECTORS

GERMANIUM SELENIDES
Molecular dynamics simulation of mass and charge transport in superionic conductors, and structural correlations in chalcogenide glasses, 15:37300 (BA;US)

GERMS (MICROORGANISMS)
See MICROORGANISMS

GIANT RESONANCE
Excitation and photon decay of giant multipole resonances, 15:37880 (R;US)
High resolution investigation of giant resonances, 15:37840 (RA;JP)
Light ion reaction, 15:37905 (RA;JP;In Japanese)
Thermal and angular momentum effects in the giant-dipole-resonance decay of hot rare-earth nuclei, 15:37877 (J;US)
[Understanding the variety of nuclear excitations]: Foreign trip report, May 19–26 1990, 15:37838 (R;US)

GLASS
See also BOROSILICATE GLASS
PHOSPHATE GLASS
Four-wave mixing of Nd^{3+}-doped crystals and glasses, 15:37324 (J;US)
Non-random mixing and fast ion decoupling in lithium chloroborate superionic glasses: An ion dynamics computer simulation study, 15:37301 (BA;US)
Properties of electrolyte and electrode films prepared by rf and dc magnetron sputtering, 15:37247 (BA;US)
Species-diffusion phenomena in glass: A one-dimensional, transient model, 15:37297 (R;US)
Structural changes in fast ion conducting chloride Doped potassium borate glasses, 15:37303 (BA;US)
Vitreous joining of SiC fiber reinforced SiC composites, 15:37284 (R;US)

GLOBULINS-GAMMA
Improved method for the direct labeling of antibodies with Tc-99m, 15:37647 (R;US)
One step Tc-99m labeling of antibodies for use in inflammation imaging, 15:37646 (R;US)

GLUCOSIDASE
Cellulase: A key enzyme for fermentation feedstocks: Progress report, September 1, 1987–August 31, 1988, 15:37631 (R;US)
Cellulase: A key enzyme for fermentation stocks: Final report, 1987–1989, 15:37632 (R;US)
Cellulase: A key enzyme for fermentation stocks: Progress report, 1989–1990, 15:37633 (R;US)

GLUONS
The structure of gluon radiation in QCD, 15:37813 (J;US)

GOBAR GAS
See METHANE

GOLD
Calculation of magnetic impurities in a nonmagnetic host: Fe in Au, 15:37224 (J;US)
Flashlamp-pumped dye and excimer laser planarization of thin metal films, 15:37957 (BA;US)
Process margins for laser planarization of 1 to 5 μm gold films, 15:37958 (BA;US)

GOLD 197 TARGET
Nucleus-nucleus collisions at 60 to 200 GeV/nucleon: Results from the WA80 experiment at CERN, 15:37881 (R;US)

GRAIN ALCOHOL
See ETHANOL

GRAIN BOUNDARIES
Diffusion-accommodated grain boundary sliding in a polycrystal, 15:37179 (R;US)
Enhanced ionic conductivity in composite electrolytes, 15:37307 (BA;US)
Molecular dynamics simulations of grain-boundary diffusion for varying tilt angle geometries, 15:37196 (R;US)

GRANULAR BED FILTERS
Performance analysis of a screenless (counter-current) Granular Bed Filter on a subpilot-scale PFBC [pressurized fluidized-bed combustor], Volume 1: Final report, 15:36889 (R;US)

GRAPHITE
Combustion testing and thermal modeling of proposed CIT [Compact Ignition Tokamak] graphite tile materials, 15:38257 (R;US)
Densification studies of refractory materials using Hot Isostatic Pressing (HIP) and tantalum containment, 15:37243 (R;US)
Metal/graphite - composites in fusion engineering, 15:38134 (RA;US)
Safety implications of a graphite oxidation accident in the Compact Ignition Tokamak device, 15:38248 (RA;US)

GRAPHITE MODERATOR
See GRAPHITE

GRASSHOPPERS
Herbivore responses to plants grown in enriched carbon dioxide atmospheres: Progress report, 15:37658 (R;US)

GRAVITATION
Important experiments to test for longer-ranged new gravitational forces, 15:37992 (R;US)
Null result for the weight change of a spinning gyroscope, 15:37780 (J;US)

GREEN RIVER FORMATION
Characteristics of pyrobitumen and oil obtained from the pyrolysis of Tipton member Green River oil shale, 15:36756 (J;US)

GREENHOUSE EFFECT
Global climate change and human health: Information needs, research priorities, and strategic considerations, 15:37563 (R;US)
Global energy and the greenhouse issue, 15:36710 (J;GB)
Report of a workshop on using remote sensing to estimate land use change, 15:37600 (R;US)
Research on CO_2-induced climate change: Final report, 15:37566 (R;US)
Sixth annual Gatlinburg acid rain conference: Proceedings, 15:37679 (R;US)
The greenhouse effect and acid rain: A tutorial, 15:37580 (R;US)
The potential impact of conservation and alternative energy sources on carbon dioxide emissions, 15:37017 (R;US)

GRENOBLE REACTOR
Taking into account a reactivity accident in research reactors design, 15:36951 (R;FR;In French)

GRIDS
Numerical investigation of the plasma-grid interaction of the LBL HIF source, 15:37503 (BA;US)

GROSS-NEVEU MODEL
See LAGRANGIAN FIELD THEORY

GROUND DISPOSAL
The effects of land disposal restrictions for certain hazardous-waste contaminated soil and debris on energy-related industries: Final report, 15:37149 (R;US)
UNSAT-H Version 2.0: Unsaturated soil water and heat flow model, 15:36784 (R;US)

GROUND MOTION
Spherical element bulking mechanisms for modeling blasting induced rock motion, 15:36754 (R;US)

GROUND WATER
Advances in air-stripper technology, 15:37612 (R;US)
Application of the finite-element program NAMMU for a model of a radioactive waste repository site, 15:36765 (R;DE;In German)

Environmental assessment for 881 Hillside (High Priority Sites) interim remedial action, 15:36797 (R;US)
Groundwater Protection Management Program, 15:37614 (R;US)
Microbial biomass and activities associated with subsurface environments contaminated with chlorinated hydrocarbons, 15:37626 (J;US)
NTS [Nevada Test Site] Mesa recharge study FY 1988: Letter report, 15:37615 (R;US)
Radium contamination in the environment. January 1972-July 1989 (A Bibliography from Pollution Abstracts). Report for January 1972-July 1989, 15:37620 (R;US)
Technology evaluation report: SITE program demonstration of the Ultrox International ultraviolet radiation/oxidation technology, 15:37619 (R;US)
The reaction of glass during gamma irradiation in a saturated tuff environment: Part 4, SRL 165, ATM-1c, and ATM-8 glasses at 1E3 R/h and O R/h, 15:36764 (R;US)
Uncertainty in exposure and health-risk assessment: An integrated approach, 15:37623 (R;US)

GROUND-WATER RESERVES
See AQUIFERS

GUATEMALA
Tecuamburro Volcano, Guatemala geothermal gradient core hole drilling, operations, and preliminary results, 15:36863 (R;US)

GUNS
Selecting appropriate test targets for portal weapons detection, 15:37380 (R;US)

GYROSCOPES
Null result for the weight change of a spinning gyroscope, 15:37780 (J;US)

GYROTRONS
See MICROWAVE AMPLIFIERS

H

HAAG-ARAKI FIELD THEORY
See ALGEBRAIC FIELD THEORY

HABITAT
Distribution, habitat and habits of the desert tortoise (Gopherus agassizii) in the eastern Mojave Desert, 15:37595 (R;US)

HADRONS
See also BARYONS
MESONS
Dilepton and dihadron production in proton-nucleus collisions at 800 GeV, 15:37759 (R;US)

HAFNIUM ISOTOPES
[The decay properties of neutron-deficient hafnium isotopes]: Foreign trip report, May 19, 1990–May 31, 1990, 15:37876 (R;US)

HALIDES
New selective anion-exchange resins for nitrate removal from contaminated drinking water and studies on analytical anion-exchange chromatography, 15:37616 (R;US)

HALL EFFECT
Electrodynamical properties of gapless edge excitations in the fractional quantum Hall states, 15:37962 (J;US)

HANDLING (DATA)
See DATA PROCESSING

HANDLING (MATERIALS)
See MATERIALS HANDLING

HANDLING (WASTES)
See WASTE MANAGEMENT

HANFORD RESERVATION
Basalt Waste Isolation Project exploratory shaft site: Final reclamation report, 15:37601 (R;US)
Hanford Environmental Dose Reconstruction Project: Monthly report, 15:37579 (R;US)
Westinghouse Hanford Company environmental surveillance annual report – 200/600 Areas: Calendar year 1989, 15:37624 (R;US)

HARD X RADIATION
Microsources of intense fusion in focused discharges of plasma focus, 15:38299 (BA;US)

HASTELLOY C-276
See HASTELLOYS

HASTELLOY C-4
See HASTELLOYS

HASTELLOYS
An initial comparison of pitting resistance of alloys for potential geothermal applications, 15:36869 (R;US)

HAZ
See HEAT AFFECTED ZONE

HAZARDOUS MATERIALS
Crucible melts and bench-scale ISV [in situ vitrification] tests on simulated wastes in INEL [Idaho National Engineering Laboratory] soils, 15:36786 (R;US)
Descriptions of research sites in the integrated forest study on effects of atmospheric deposition, 15:37678 (R;US)
Environmental compliance assessment findings for Weldon Spring Site Remedial Action Program, 15:36805 (R;US)
Initial tests on in situ vitrification using electrode feeding techniques, 15:36787 (R;US)
On the implementation of complex many-to-many relations in focus, 15:38321 (R;US)
Proceedings of the 6th national conference on hazardous wastes and hazardous materials, 15:37605 (B;US)
Redesign of the PREPP [Process Experimental Pilot Plant] feed, ash discharge and sludge handling systems, 15:36778 (R;US)
The effects of land disposal restrictions for certain hazardous-waste contaminated soil and debris on energy-related industries: Final report, 15:37149 (R;US)
Toward more realistic material models for release and dispersion of heavy gases, 15:37587 (R;US)
Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education: Volume 1, Overview and general waste management: Proceedings, 15:36772 (R;US)
[Environmental toxicology]: Foreign trip report, November 11–21, 1988, 15:37674 (R;US)
[Health risk assessment on environmental, occupational, and life style hazards]: Foreign trip report, December 12–30, 1988, 15:37675 (R;US)

HBTX DEVICES
Advanced wall reversed field pinch, 15:38157 (RA;US)

HEALTH PHYSICS
See RADIATION PROTECTION

HEAT
See also WASTE HEAT
A high-speed beam of lithium droplets for collecting diverted energy and particles in ITER (International Thermonuclear Experimental Reactor), 15:38210 (RA;US)

HEAT AFFECTED ZONE
The significance of local hard zones on the outside of pipeline girth welds: Final report, 15:36735 (R;GB)

HEAT CAPACITY
See SPECIFIC HEAT

HEAT ENGINES
See also STIRLING ENGINES
Outlook for ceramics in heat engines, 1990–2010: A technical and economic assessment based on a worldwide Delphi survey, 15:37156 (R;US)

HEAT EXCHANGERS
Analysis of air-to-air heat exchanger performance data taken under the Residential Standards Demonstration Program, 15:37128 (R;US)
The development of an expert system for heat exchanger selection, 15:37152 (R;GB)
Trends in dish-Stirling solar receiver designs, 15:36859 (R;US)

HEAT FLOW
UNSAT-H Version 2.0: Unsaturated soil water and heat flow model, 15:36784 (R;US)

HEAT PIPES
Maintaining optimum light output with a thermally conductive heat pipe, 15:37120 (R;US)
Trends in dish-Stirling solar receiver designs, 15:36859 (R;US)

HEAT PUMPS
A magnetically coupled Stirling engine driven heat pump: Design optimization and operating cost analysis, 15:37143 (R;US)
ARC: Chemical heat pumps, 15:37125 (R;FR;In French)
Hardware development and initial subassembly test of a gas-fired Stirling/Rankine residential heat pump, 15:37145 (R;US)
Selection of ozone-safe, nonazeotropic refrigerant mixtures for capacity modulation in residential heat pumps, 15:37130 (BA;US)

HEAT SINKS
Utilization of off-peak electric power to improve cycle efficiency during peak demand periods, 15:36887 (R;US)

HEAT STORAGE DEVICES
See THERMAL ENERGY STORAGE EQUIPMENT

HEAT STORAGE SYSTEMS
See THERMAL ENERGY STORAGE EQUIPMENT

HEAT TRANSFER
Analysis of a DRACS [Direct Reactor Auxiliary Cooling System] test COMMIX validation, 15:36922 (R;US)
Developing convection above a finite horizontal surface, 15:37388 (R;US)
Microcomputer based program for predicting heat transfer under reactor accident conditions. Volume I: Text, 15:36913 (R;CA)

HEAT TRANSMISSION
See HEAT TRANSFER

HEATING SYSTEMS
See also SOLAR HEATING SYSTEMS
Control system for the Texas Experimental Tokamak ECRH system, 15:38242 (RA;US)
First JT-60 system high power 110 to 130 MHz test results with an X2242 tetrode, 15:38236 (RA;US)
First tests of the Varian EIMAC X2242 at 110 and 130 MHz in the JT-60 ICRH system, 15:38252 (RA;US)
Impact of heating and air conditioning system operation and leakage on ventilation and intercompartment transport: Studies in unoccupied and occupied Tennessee Valley homes, 15:37137 (J;US)
Microwave Tokamak Experiment (MTX) ohmic heating system, 15:38220 (RA;US)
Thermal and stress analysis of the Faraday shield for the ORNL/TFTR RF antenna, 15:38237 (RA;US)

HEAVY ION ACCELERATORS
See also HHIRF ACCELERATOR
NAC CYCLOTRON
Beam studies in the L.B.L. MBE-4 device, 15:38297 (BA;US)
Numerical investigation of the plasma-grid interaction of the LBL HIF source, 15:37503 (BA;US)
Progress in 3D particle-in-cell modeling of heavy ion beam transport in quadrupole focusing channels, 15:38067 (BA;US)
Research on multiple-beam induction linacs for heavy ion inertial fusion, 15:38303 (BA;US)

HEAVY ION FUSION REACTIONS
Magnetic field effects in electrostatic analyzers used for heavy ion beam probe measurements, 15:38081 (BA;US)
Research on multiple-beam induction linacs for heavy ion inertial fusion, 15:38303 (BA;US)

HEAVY ION REACTIONS
See also ARGON 40 REACTIONS
LITHIUM 6 REACTIONS
MAGNESIUM 24 REACTIONS
OXYGEN 16 REACTIONS
OXYGEN 17 REACTIONS
SILICON 28 REACTIONS
SULFUR 32 REACTIONS
SULFUR 34 REACTIONS
URANIUM 238 REACTIONS
A search for long-lived low mass states coupling to e^+e^-, 15:37825 (R;US)
Charged particle distributions in heavy ion collisions at 14.6 GeV A/c, 15:37824 (R;US)
Experimental results from studies on nucleus-nucleus collisions at high energy, 15:37826 (R;US)
Microscopic study of the ^{238}U-^{238}U system and anomalous pair production, 15:37888 (J;US)
Multinucleon transfer reactions for the ^{50}Ti+^{93}Nb system at sub- and near-barrier energies, 15:37869 (R;US)
[Heavy-ion nuclear reactions]: Foreign trip report, June 10, 1988–August 2, 1988, 15:37899 (R;US)
Z dependence of Coulomb dissociation cross sections in heavy ion reactions, 15:37915 (J;US)

HEAVY OILS
See PETROLEUM
VISCOSITY

HEAVY WATER MODERATED REACTORS
See also GRENOBLE REACTOR
Reactivity studies on the final preconceptual reference design of the Advanced Neutron Source, 15:36950 (R;US)

HEISENBERG MODEL
Geometric phase in the classical continuous antiferromagnetic Heisenberg spin chain, 15:37961 (J;US)

HELIANTHUS ANNUUS
See SUNFLOWERS

HELIOTRON
Design and construction of the neutral beam injector for compact helical system (CHS), 15:38240 (RA;US)
Present status of the Large Helical Device project, 15:38150 (RA;US)

HELIUM
Ash and burn control in ITER-type tokamak, 15:38291 (BA;US)
Binary-encounter electrons observed at 0° in collisions of 1–2-MeV/amu H^+, C^{6+}, N^{7+}, O^{8+}, and F^{9+} ions with H_2 and He targets, 15:37728 (J;US)
Co-pumping of deuterium-helium and tritium-helium mixtures at TSTA, 15:38135 (RA;US)
Emission spectroscopy of ECRH non-axisymmetric helium mirror plasmas, 15:38080 (BA;US)
Experimental design of spectroscopic measurements of microwave electric field in MTX tokamak plasma, 15:38079 (BA;US)
Holographic interferometry of gas-puff Z-pinches, 15:38075 (BA;US)
Mechanisms of double excitation in ion-atom collisions at high velocities, 15:37726 (J;US)
Radiofrequency ionization of helium with turbulent flow-measurements versus theory, 15:38289 (BA;US)

HELIUM 3
Nuclear charge symmetry breaking and quantum-chromodynamically-induced corrections to quantum electrodynamics, 15:37917 (J;US)

HELIUM 3 REACTIONS
Nuclear physics through charge-exchange reactions, 15:37847 (RA;JP;In Japanese)
Polarized ^3He beam with intermediate energies: sup 3He elastic scattering and (sup 3He, sup 2He) reaction, 15:37900 (RA;JP;In Japanese)

HELIUM 3 TARGET
Exclusive photonuclear reactions and asymptotic scaling, 15:37916 (J;US)
Polarized 3He gas target, 15:37844 (RA;JP;In Japanese)

HELIUM 4
Deep-inelastic neutron scattering from liquid ^4He, 15:37749 (J;US)
Nuclear charge symmetry breaking and quantum-chromodynamically-induced corrections to quantum electrodynamics, 15:37917 (J;US)
Three-dimensional random *XY* model: Application to the superfluid transition of ^4He in porous media, 15:37750 (J;US)

HELIUM 4 TARGET
Experimental nuclear physics: The reaction sup 4He(p,p'1X) for X=p,d,t,sup 3He at an incident energy of 100 MeV, 15:37845 (RA;ZA)

HELIUM ASH
Influence of MHD effects and edge conditions on ITER helium ash accumulation and sustained ignition, 15:38035 (R;US)
Measurements of radial profiles of He^{2+} transport coefficients on TFTR [Tokamak Fusion Test Reactor], 15:38034 (R;US)

HELIUM IONS
See also HELIUM ASH

Curve-fitting analysis of time-resolved Thomson spectrograms from a plasma focus, 15:38070 (BA;US)

HERA STORAGE RING
Data acquisition system realization for H1 experiment, 15:37527 (R;FR;In French)

HHIRF
See HHIRF ACCELERATOR

HHIRF ACCELERATOR
A Recoil Mass Spectrometer for the HHIRF [Holifield Heavy Ion Research Facility] facility, 15:37518 (R;US)

HIGH ENERGY PHYSICS
B-factories: A perspective of β-physics and possible accelerator design approaches, 15:37436 (RA;US)
High energy nuclear physics, 15:37751 (R;FR;In French)
Particle physics experiments 1989, 15:37443 (R;GB)

HIGH EXPLOSIVES
See CHEMICAL EXPLOSIVES

HIGH SPIN STATES
The importance of gamma-ray measurement in nuclear reaction research, 15:37839 (RA;JP;In Japanese)

HIGH-BETA PLASMA
Plasma motion into a transverse magnetic field and plasma, 15:38060 (BA;US)

HIGH-LEVEL RADIOACTIVE WASTES
Doses to railroad workers exposed to shipments of high-level radioactive waste, 15:36804 (R;US)
Hanford Waste Vitrification Plant foreign alternatives feasibility study: Revision 1, 15:36777 (R;US)
Physical and chemical characteristics of topographically affected airflow in an open borehole at Yucca Mountain, Nevada, 15:36771 (R;US)
Sandia Sorption Data Management System, Version 2 (SSDMS II): User's manual, 15:36788 (R;US)
The reaction of glass during gamma irradiation in a saturated tuff environment: Part 4, SRL 165, ATM-1c, and ATM-8 glasses at 1E3 R/h and O R/h, 15:36764 (R;US)
Verification of product quality from process control, 15:36776 (R;US)

HIGH-TC SUPERCONDUCTORS
High temperature superconducting compounds: Processing and related properties; Proceedings of the Symposium on High Temperature Superconducting Oxides: Processing and Related Properties, Las Vegas, NV, Feb. 27, 28, 1989, 15:37245 (B;US)
High-temperature superconductivity: Perseverance and cooperation on the road to commercialization, 15:37981 (R;US)
Large, orientation-dependent enhancements of critical currents in $Y_1Ba_2Cu_3O_{7-x}$ epitaxial thin films: Evidence for intrinsic flux pinning?, 15:37228 (R;US)
Materials research issues in superconducting levitation and suspension as applied to magnetic bearings, 15:37227 (R;US)
NDE [nondestructive evaluation] of critical currents in high T_c superconductors, 15:37233 (R;US)
Prospects for RF application of high TC superconductors, 15:37467 (RA;US)
[Theory of exotic superconducting and normal states of heavy electron and high T_c materials]: [Progress report], 15:37977 (R;US)

HIGH-VOLTAGE PULSE GENERATORS
A repetitive, one microsecond, thirty-five kilojoule, two hundred kilovolt pulse generator, 15:37408 (R;US)

HIGHWAYS
See ROADS

HOLIFIELD HEAVY ION RESEARCH FACILITY
See HHIRF ACCELERATOR

HOLMIUM
Determination of the valence of Pr, Gd, and Ho in $YBa_2Cu_3O_7$ by x-ray absorption spectroscopy, 15:37221 (J;US)

HORIZONTAL AXIS TURBINES
Pressure measurements on a 5.35 m hawt in CARDC wind tunnel compared to theoretical pressure distributions, 15:36878 (R;SE)

HOT GAS CLEANUP
Spray-dryer flue-gas-cleaning systems handbook, 15:36892 (R;US)

HOT-DRY-ROCK SYSTEMS
Modeling the hydraulic characteristics of the Fenton Hill, New Mexico Hot Dry Rock reservoir, 15:36860 (R;US)
Progress in hot dry rock technology development, 15:36870 (R;US)

HOUSES
Characterizing the occurrence, sources, and variability of radon in pacific northwest homes, 15:37591 (J;US)
Impact of heating and air conditioning system operation and leakage on ventilation and intercompartment transport: Studies in unoccupied and occupied Tennessee Valley homes, 15:37137 (J;US)
Radon-measurement comparison study, Butte, Montana-68 homes, 15:37573 (R;US)
The Residential Building Characteristics On-Site Inspection: Summary report, 15:37127 (R;US)

HUGENHOLTZ-PINES THEORY
See HYDROGEN

HUMAN POPULATIONS
Hanford Environmental Dose Reconstruction Project: Monthly report, 15:37579 (R;US)
Literature review of cask exterior surface contamination with application to a nuclear repository, 15:37379 (R;US)
Off-Site Radiation Exposure Review Project: Phase 2 soils program: Revision, 15:37596 (R;US)
Testing methodologies, 15:37663 (R;US)
Uncertainty in exposure and health-risk assessment: An integrated approach, 15:37623 (R;US)

HUMANS
See HUMAN POPULATIONS

HYDRIDES
See also SILANES
Advanced hydride laboratory, 15:36820 (BA;US)

HYDROCARBONS
See also ALKANES
ALKENES
ALKYNES
BENZOPYRENE
BIPHENYL
NAPHTHALENE
PYRENE
Application of the absorption of seismic waves in hydrocarbon exploration, 15:36719 (R;DE)
Contribution on the study of light non methane hydrocarbons sources in the atmosphere, 15:37569 (R;FR;In French)
Mechanism of hydrodenitrogenation: Part 1, Preparation and characterization of acidic supports, 15:36696 (R;US)
Vibrational pressure tuning spectroscopy of the polymethylene chain. 1. Various n-alkanes from C_8H_{18} to $C_{36}H_{74}$, 15:37360 (J;US)

HYDRODYNAMICS
See also MAGNETOHYDRODYNAMICS
A lattice gas model for thermohydrodynamics, 15:37740 (R;US)
Properties of confined states in phase dynamics, 15:37747 (J;US)

HYDROGEN
Binary-encounter electrons observed at 0° in collisions of 1–2-MeV/amu H^+, C^{6+}, N^{7+}, O^{8+}, and F^{9+} ions with H_2 and He targets, 15:37728 (J;US)
Bond-selected bimolecular chemistry: $H+HOD(4\nu_{OH}) \rightarrow OD+H_2$, 15:37354 (J;US)
Charge transfer and electron detachment for collisions of H^- and D^- with H, 15:37731 (J;US)
Dependence of H^- production upon the work function of a Mo surface in a cesiated hydrogen discharge, 15:37211 (J;US)
Excitation of atomic hydrogen by fully stripped ions, 15:37729 (J;US)
Laser effects in photoionization. II. Numerical solution of coupled equations for atomic hydrogen, 15:37733 (J;US)
Optical pulses in tritiated solid hydrogen, 15:37974 (J;US)
Production of negative hydrogen ions in neutral H+H collisions, 15:37727 (J;US)

HYDROGEN 1 TARGET
Parity-violating asymmetry in $\vec{p}\,p$ scattering at medium energies, 15:37911 (J;US)
HYDROGEN 2
See DEUTERIUM
HYDROGEN 3
See TRITIUM
HYDROGEN 4
Nuclear charge symmetry breaking and quantum-chromodynamically-induced corrections to quantum electrodynamics, 15:37917 (J;US)
HYDROGEN DEUTERIDE
The intramolecular kinetic isotope effect for the reaction $O(^3P)$+HD, 15:37363 (J;US)
HYDROGEN HYDROXIDES
See WATER
HYDROGEN IONS 1 MINUS
Charge transfer and electron detachment for collisions of H^- and D^- with H, 15:37731 (J;US)
Dependence of H^- production upon the work function of a Mo surface in a cesiated hydrogen discharge, 15:37211 (J;US)
HYDROGEN IONS 1 PLUS
Binary-encounter electrons observed at 0° in collisions of 1–2-MeV/amu H^+, C^{6+}, N^{7+}, O^{8+}, and F^{9+} ions with H_2 and He targets, 15:37728 (J;US)
HYDROGEN IONS 2 PLUS
Recombination and dissociation of H_2^+ and H_3^+ ions on surfaces to form $H_2(v'')$: Negative-ion formation on low-work-function surfaces, 15:37736 (J;US)
HYDROGEN IONS 3 PLUS
Recombination and dissociation of H_2^+ and H_3^+ ions on surfaces to form $H_2(v'')$: Negative-ion formation on low-work-function surfaces, 15:37736 (J;US)
HYDROGEN PRODUCTION
A mass transport model for hydrogen generation during lithium-lead/water interactions, 15:38172 (RA;US)
HYDROGEN STORAGE
Advanced hydride laboratory, 15:36820 (BA;US)
HYDROLASES
Cellulase: A key enzyme for fermentation feedstocks: Progress report, September 1, 1987–August 31, 1988, 15:37631 (R;US)
Cellulase: A key enzyme for fermentation stocks: Final report, 1987–1989, 15:37632 (R;US)
Cellulase: A key enzyme for fermentation stocks: Progress report, 1989–1990, 15:37633 (R;US)
HYDROXYL RADICALS
Bond-selected bimolecular chemistry: $H+HOD(4\nu_{OH})\rightarrow OD+H_2$, 15:37354 (J;US)
Hydroxyl radical concentration measurements in a turbulent flow reactor using a high temperature laser induced fluorescence probe, 15:37372 (BA;US)
HYPERFRAGMENTS
See HYPERNUCLEI
HYPERNUCLEI
A proposal to study double-Λ hypernuclei and H-dibaryon by using a 4π-type spectrometer, 15:37761 (R;JP)
Hypertriton: $\Lambda\leftrightarrow\Sigma$ conversion and tensor forces, 15:37918 (J;US)

I

I CODES
Integrated Reliability and Risk Analysis System (IRRAS) Version 2.0 user's guide, 15:36980 (R;US)
I-BEAM TYPE REACTORS
See ION BEAM FUSION REACTORS
IAN
Progress report 1984, 15:38310 (R;CO;In Spanish)
Progress report 1987, 15:38311 (R;CO;In Spanish)
Progress report 1988, 15:38312 (R;CO;In Spanish)
IBR-1
See IFR REACTOR
ICE
Utilization of off-peak electric power to improve cycle efficiency during peak demand periods, 15:36887 (R;US)
ICF DEVICES
Dose rate calculations for a light ion beam fusion Laboratory Microfusion Facility, 15:38233 (RA;US)
Laboratory microfusion facility - Neutronics and radiological safety analysis, 15:38223 (RA;US)
Sirius-T, a symmetrically illuminated ICF tritium production facility, 15:38234 (RA;US)
IDAHO NATIONAL ENGINEERING LABORATORY
Groundwater Protection Management Program, 15:37614 (R;US)
Internal dosimetry and control, 15:37667 (R;US)
IDENTIFICATION SYSTEMS
A performance evaluation of biometric identification devices, 15:38346 (R;US)
IFR REACTOR
Run - Beyond - Cladding - Breach (RBCB) test results for the Integral Fast Reactor (IFR) metallic fuels program, 15:36946 (R;US)
Transient feedback from fuel motion in metal IFR [Integral Fast Reactor] fuel, 15:36954 (R;US)
Whole-Pin Furnace system: An experimental facility for studying irradiated fuel pin behavior under potential reactor accident conditions, 15:36961 (R;US)
IGNITION (THERMONUCLEAR)
See THERMONUCLEAR IGNITION
ILLUMINANCE
Maintaining optimum light output with a thermally conductive heat pipe, 15:37120 (R;US)
ILLUMINATION
See ILLUMINANCE
IMAGE PROCESSING
Depth buffer shadow algorithms, 15:38338 (R;US)
Pixar data visualization tools overview, 15:38335 (R;US)
IMAGES
Depth buffer shadow algorithms, 15:38338 (R;US)
IMPERMEABLE DRY ROCK
See HOT-DRY-ROCK SYSTEMS
INCANDESCENT LAMPS
See LIGHT BULBS
INCIDENTS
See ACCIDENTS
INCLUSION COMPLEXES
See CLATHRATES
INCOMPLETE FUSION REACTIONS
Influence of the mass asymmetry of the entrance channel on incomplete fusion processes, 15:37894 (R;FR)
INCONEL 718
Electrothermal evaluation of conductors for the Compact Ignition Tokamak (CIT) PF coils, 15:38097 (RA;US)
INDIUM ANTIMONIDES
Diffraction broadening and suppression of the inelastic channel in resonant neutron scattering, 15:37312 (J;US)
INDIUM ARSENIDES
Formation of $In_xGa_{1-x}As/GaAs$ heteroepitaxial layers using a pulsed laser driven rapid melt-solidification process, 15:37310 (J;US)
Growth studies of pseudomorphic GaAs/InGaAs/AlGaAs modulation-doped field-effect transistor structures, 15:37311 (J;US)
INDIUM BASE ALLOYS
Twin boundaries, interfaces and modulated structures in martensites: Annual progress report No. 5, July 1, 1989–June 30, 1990, 15:37184 (R;US)
INDUSTRIAL ACCIDENTS
Hazard rate for a two-channel protective system subject to a high demand rate, 15:37385 (BA;US)
INDUSTRIAL RADIOGRAPHY
X-ray lithography studies of polysilane using a laser plasma x-ray source, 15:37960 (BA;US)

INDUSTRIAL WASTES
The effects of land disposal restrictions for certain hazardous-waste contaminated soil and debris on energy-related industries: Final report, 15:37149 (R;US)
INDUSTRIALIZED COUNTRIES
See DEVELOPED COUNTRIES
INERTIAL CONFINEMENT
Design of thick aperture for fine-resolution neutron penumbral imaging, 15:38271 (R;US)
ICF applications studies, 15:38270 (RA;US)
Laser program overview, 15:38264 (RA;US)
Laser research and development, 15:38268 (RA;US)
Nova experiments, 15:38266 (RA;US)
Target design, 15:38265 (RA;US)
Target materials development, 15:38267 (RA;US)
INERTIAL CONFINEMENT FUSION DEVICES
See ICF DEVICES
INFORMATION SYSTEMS
A protocol to set up shared secret schemes without the assistance of a mutually trusted party, 15:38345 (R;US)
INFORMATION THEORY
A protocol to set up shared secret schemes without the assistance of a mutually trusted party, 15:38345 (R;US)
INHOMOGENEOUS PLASMA
Development of a laser diagnostic system at PBFA II for light-ion-beam research, 15:38088 (BA;US)
Thermal instability in current-carrying plasmas, 15:38083 (BA;US)
INSOLATION
The synthesis of solar radiation data for sizing stand-alone photovoltaic systems, 15:36844 (R;US)
INSTRUMENTS (MEASURING)
See MEASURING INSTRUMENTS
INSULATING LIMITERS
See LIMITERS
INSULATION (THERMAL)
See THERMAL INSULATION
INSULATORS (ELECTRICAL)
See ELECTRICAL INSULATORS
INTERCALATES
See CLATHRATES
INTERFACES
Incoherent imaging of materials structure and composition by Z-contrast stem, 15:37281 (R;US)
INTERMEDIATE MASS NUCLEI
See also COBALT 60
KRYPTON 85
NICKEL 56
NICKEL 60
OSMIUM 174
OSMIUM 175
OSMIUM 180
PLATINUM 177
STRONTIUM 82
STRONTIUM 90
TECHNETIUM 99
TIN 110
TIN 114
TITANIUM 44
XENON 133
Influence of neutron and proton alignments on the shape of A = 120-130 transitional nuclei, 15:37870 (R;FR)
INTERMEDIATE-LEVEL RADIOACTIVE WASTES
Handling, conditioning and disposal of spent sealed sources: Technical manual for the management of low and intermediate level wastes generated at small nuclear research centres and by radioisotope users in medicine, research and industry, 15:37937 (R;XA)
INTERMETALLIC COMPOUNDS
Phase transitions in CsCl-type intemetallic compounds, 15:37190 (R;US)
INTERNAL CONVERSION
Inverse internal conversion processes, 15:37719 (RA;JP;In Japanese)
INTERSECTING BEAMS
See COLLIDING BEAMS
IODINE
Nuclear-induced UV fluorescence, 15:37720 (BA;US)
IODINE IODIDES
See IODINE
ION ACOUSTIC WAVES
Effects of higher-order dispersion on envelope solitons, 15:38054 (BA;US)
ION BEAM FUSION REACTORS
Activation analysis for the LIBRA light ion beam fusion conceptual design, 15:38222 (RA;US)
Design of a light-ion-beam driver for the Laboratory Microfusion Facility, 15:38262 (R;US)
ION BEAM TYPE REACTORS
See ION BEAM FUSION REACTORS
ION BEAMS
Effects of beam perveance to the performance characteristics of the electrically electron-suppressed beam direct converter with secondary electron suppressor grids, 15:38162 (RA;US)
Theory of multistage intense ion-beam acceleration, 15:37464 (J;US)
ION DETECTION
A rotating catcher system (CAROT) for a decay study of projectile fragmentation, 15:37497 (RA;JP;In Japanese)
ION EXCHANGE MATERIALS
New selective anion-exchange resins for nitrate removal from contaminated drinking water and studies on analytical anion-exchange chromatography, 15:37616 (R;US)
ION EXCHANGE MEMBRANES
See ION EXCHANGE MATERIALS
MEMBRANES
ION SOURCES
Beam current regulation of DIII-D neutral beam long pulse ion sources, 15:38142 (RA;US)
Construction of the RCNP polarized heavy ion source, 'HISPANIOLA', 15:37498 (RA;JP)
Curve-fitting analysis of time-resolved Thomson spectrograms from a plasma focus, 15:38070 (BA;US)
The laser system of the optically pumped ion source at TRIUMF, 15:37500 (R;CA)
IONIC REACTIONS
See CHEMICAL REACTIONS
IONS
IONIZATION CALORIMETERS
See SHOWER COUNTERS
IONIZING RADIATIONS
See also COSMIC RADIATION
GAMMA RADIATION
X RADIATION
Testing methodologies, 15:37663 (R;US)
IONOSPHERE
Coordinated observations of high-latitude ionospheric turbulence, 15:37704 (R;US)
[Workshop on artificially ionized layers in the atmosphere]: Foreign trip report, October 5–14, 1989, 15:37568 (R;US)
IONS
See also BROMINE IONS
CARBON IONS
DEUTERIUM IONS
FLUORINE IONS
HELIUM IONS
KRYPTON IONS
LITHIUM IONS
MAGNESIUM IONS
MULTICHARGED IONS
NEODYMIUM IONS
NICKEL IONS
NITROGEN IONS
OXYGEN IONS
SELENIUM IONS
XENON IONS
Ion betatron, 15:38288 (BA;US)

Regular and chaotic motion of classical electrons in the wake potential of fast ions in solids, 15:37933 (J;US)
Vacuum ultraviolet radiation from neon implosions, 15:38301 (BA;US)

IRIDIUM 181
Lifetimes of high spin states in ^{181}Ir and ^{180}Os, 15:37878 (J;US)

IRIDIUM ALLOYS
Elucidation of the specific-heat anomaly below T_N in $NpIr_2$, 15:37223 (J;US)
Operational readiness review plan for the radioisotope thermoelectric generator materials production tasks, 15:37043 (R;US)

IRON
Molecular dynamics simulations of grain-boundary diffusion for varying tilt angle geometries, 15:37196 (R;US)
Stability of laser-induced retained austenite in ductile iron, 15:37200 (BA;US)

IRON 54 TARGET
Analysis of pion scattering to stretched states in ^{60}Ni and other nuclei using Woods-Saxon wave functions, 15:37854 (J;US)

IRON ALLOYS
See also ALLOY-NI73CR15FE7TI3
AUSTENITE
IRON BASE ALLOYS
MARTENSITE
Center conductor design for the compact Spherical Torus reactor, 15:38126 (RA;US)
Lorentz electron microscopy of iron-rare-earth-boron sintered permanent magnets, 15:37212 (J;US)
Microstructure of melt spun Nd-Fe-Co-B magnets, 15:37209 (J;US)
Weldability of iron aluminides, 15:36691 (R;US)

IRON BASE ALLOYS
See also STEELS
Development of surface treatments and alloy modifications for corrosion-resistant oxide scales, 15:36692 (R;US)
Moisture-induced embrittlement of Fe_3Al, 15:36690 (R;US)

IRON COMPOUNDS
Enhanced flue gas denitrification using ferrous EDTA and a polyphenolic compound having combined antioxidant and reducing properties, 15:36706 (R;US)
Use of ferrous chelates for NO_x control in aqueous scrubbers, 15:36707 (R;US)

IRON-FREE SPECTROMETERS
See FLAT MAGNETIC SPECTROMETERS

IRRADIATION DEVICES
Biophysical sciences: Physical characteristics of the neutron therapy unit, 15:37649 (RA;ZA)

IRRADIATION RIGS
See IRRADIATION DEVICES

IRREDUCIBLE REPRESENTATIONS
The unitary irreducible representations of SU(2,1), 15:37996 (J;US)

ISOTOPE SEPARATION PLANTS
See also CENTRIFUGE ENRICHMENT PLANTS
GASEOUS DIFFUSION PLANTS
Safeguards training course: Nuclear material safeguards for enrichment plants: Part 4, Gas centrifuge enrichment plant: Diversion scenarios and safeguards activities, 15:36812 (R;US)

ITER TOKAMAK
A high-speed beam of lithium droplets for collecting diverted energy and particles in ITER (International Thermonuclear Experimental Reactor), 15:38210 (RA;US)
A neutral particle beam system for ITER with rf acceleration, 15:38239 (RA;US)
A radiation-cooled armor tile design for the first wall of ITER (International Thermonuclear Experimental Reactor), 15:38128 (RA;US)
Analysis of quench-vent pressures for present design of ITER [International Thermonuclear Experimental Reactor] TF [toroidal field] coils, 15:38100 (RA;US)
Ash and burn control in ITER-type tokamak, 15:38291 (BA;US)
Characteristics of an electron-beam rocket pellet accelerator, 15:38195 (RA;US)
Design of the ITER (International Thermonuclear Experimental Reactor) neutral beam system beamline, United States concept, 15:38238 (RA;US)
ITER [International Thermonuclear Experimental Reactor] guide for reliability analysis, 15:38108 (RA;US)
Influence of MHD effects and edge conditions on ITER helium ash accumulation and sustained ignition, 15:38035 (R;US)
Passive vertical stability of ITER (International Thermonuclear Experimental Reactor), 15:38013 (RA;US)
Recommendations for a cryogenic system for ITER (International Thermonuclear Experimental Reactor), 15:38181 (RA;US)
Shielding design options for the TF magnets of ITER (International Thermonuclear Experimental Reactor), 15:38226 (RA;US)
Shielding options for the ITER conceptual design, 15:38213 (RA;US)
Tritium analysis of a water-cooled solid breeder blanket for ITER, 15:38121 (RA;US)
Two dimensional LOCA (loss-of-coolant accident) analysis for fusion reactors, 15:38187 (RA;US)

J

J PSI-3097 MESONS
Heavy flavor resonances and QED radiative corrections, 15:37799 (J;US)
New DM2 results on $D/f_1(1285)$ and $\iota/\eta(1440)$, 15:37766 (R;FR)
Study of the J/Ψ decay into five pions, 15:37764 (R;FR)
The J/Ψ → vector+pseudoscalar decays and the η, η' quark content, 15:37765 (R;FR)

J-3105 RESONANCES
See J PSI-3097 MESONS

JAERI EXPERIMENTAL FUSION REACTOR
See JXFR TOKAMAK

JERUSALEM ARTICHOKES
See SUNFLOWERS

JET MODEL
Inclusive jet cross section at $\sqrt{s}$ = 1.8 TeV, 15:37757 (R;US)
Large P_t jets at CDF, 15:37756 (R;US)

JET REACTORS
See JET TOKAMAK

JET TOKAMAK
A comparison between hypervapotron and multitube high heat flux beam stopping elements, 15:38131 (RA;US)
Beamline duct gas release conditioning and the upgraded duct wall protection system of the JET neutral injection, 15:38253 (RA;US)
Operation and reliability of a pneumatic hydrogen pellet injection system on the Joint European Torus, 15:38225 (RA;US)
Pellets in large tokamaks TFTR and JET, 15:38255 (R;US)
Pumping of gaseous helium using argon frosted liquid helium cryo-condensation pumps, 15:38180 (RA;US)
The 15 MW microwave generator and launcher of the lower hybrid current drive experiment on JET, 15:38167 (RA;US)
The control of plasma parameters to avoid high current disruptions in JET, 15:38012 (RA;US)
The control system for the multiple-pellet injector on the Joint European Torus, 15:38245 (RA;US)
Upgrading the JET pellet injector with a two-stage light gas gun prototype and future planning, 15:38203 (RA;US)

JOB TRAINING
See TRAINING

JOSEPHSON JUNCTIONS
I-V characteristics in two-dimensional frustrated Josephson-junction arrays, 15:37984 (J;US)

JT-60 REACTORS
See JT-60 TOKAMAK

JT-60 TOKAMAK
Development of upgraded pellet injector for JT-60, 15:38200 (RA;US)
Electron temperature profile measurement using the filter absorption method in JT-60, 15:38029 (R;JP)
First JT-60 system high power 110 to 130 MHz test results with an X2242 tetrode, 15:38236 (RA;US)

First tests of the Varian EIMAC X2242 at 110 and 130 MHz in the JT-60 ICRH system, 15:38252 (RA;US)
JT-60 operational experience and trouble analysis, 15:38158 (RA;US)
Operation of JT-60NBI and NBI system for JT-60 upgrade, 15:38144 (RA;US)
Present status of JT-60 upgrade, 15:38164 (RA;US)
Stress analysis of JT-60U tokamak, 15:38228 (RA;US)
Test on fast data transfer between a VME-bus system and a CAMAC system, 15:38030 (R;JP;In Japanese)

JXFR REACTOR
See JXFR TOKAMAK

JXFR TOKAMAK
Design study of the FER (fusion experimental reactor) superconducting magnet system, 15:38178 (RA;US)

K

K01
See KAONS NEUTRAL SHORT-LIVED

KAOLINITE
Revisiting kaolinite dehydroxylation: A ^{29}Si and ^{27}Al MAS NMR study, 15:37177 (J;US)

KAONS
See also KAONS NEUTRAL
Recent results from rare kaon decay experiments, 15:37779 (R;CA)
The π, K, proton electromagnetic form factors and new related DM2 results, 15:37768 (R;FR)

KAONS 1
See KAONS NEUTRAL SHORT-LIVED

KAONS NEUTRAL
See also KAONS NEUTRAL SHORT-LIVED
First evidence for direct Cp violation, 15:37767 (R;FR)
Present status of the NA31 experiment, 15:37771 (R;FR)

KAONS NEUTRAL SHORT-LIVED
Improved experimental limit on $K_L \rightarrow \pi^0 e^+ e^-$, 15:37785 (J;US)
Neutral strange particle production in antiproton-nucleus annihilation at low energies, 15:37895 (R;SU)

KAPPA-725 RESONANCES
See MESONS

KEK INTERS. STORAGE ACCELERATOR
See TRISTAN STORAGE RINGS

KEK PHOTON FACTORY
Performance of BL10B and a simple performance test for EXAFS stations, 15:37488 (R;JP)

KEROGEN
Comparison of isothermal and nonisothermal pyroylsis data with various rate mechanisms: Implications for kerogen structure, 15:36739 (J;US)

KEROSENE
Techniques for multivariate sample design, 15:36729 (R;US)

KHARKOV LINAC
Electron beam monochromatization in the linac used as an injector to the stretcher, 15:37435 (RA;US)

KLYSTRONS
A review of Gyroklystrons and a cost estimate for a Gyroklystron-driven supercollider, 15:37474 (RA;US)
Relativistic klystron research for linear colliders, 15:37475 (RA;US)
Relativistic klystron research for linear colliders, 15:37501 (R;US)
Transient analysis of multicavity klystrons, 15:37478 (RA;US)

KNOCK-ON ELECTRONS
See ELECTRONS

KRYPTON 85
Onsite environmental report for the Nevada Test Site, January 1988–December 1988, 15:37567 (R;US)

KRYPTON FLUORIDE LASERS
Prospect of multiphoton induced inner shell excitations for x-ray laser pumping, 15:38296 (BA;US)

KRYPTON IONS
Atomic electron binding energies of multiply charged krypton ions by internal-conversion-electron spectroscopy, 15:37723 (J;US)

KUR REACTOR
Installation and performance tests of KUR cold neutron source, 1: Structure and safety design, 15:36948 (RA;JP;In Japanese)

KYOTO UNIVERSITY REACTOR
See KUR REACTOR

L

LA REINA REACTOR
See RESEARCH REACTORS

LAGRANGE FIELD EQUATIONS
See LAGRANGIAN FIELD THEORY

LAGRANGIAN FIELD THEORY
Hyperextended inflation, 15:37700 (J;US)
Towards a bosonization of quantum electrodynamics, 15:37815 (J;US)

LAKES
Sulfur cycling and fluxes in temperate dimictic lakes, 15:37613 (R;US)

LAMBDA NEUTRAL
See LAMBDA PARTICLES

LAMBDA PARTICLES
Neutral strange particle production in antiproton-nucleus annihilation at low energies, 15:37895 (R;SU)

LAMPS
See LIGHT BULBS

LAND APPLICATION
See GROUND DISPOSAL

LAND USE
Report of a workshop on using remote sensing to estimate land use change, 15:37600 (R;US)

LANGMUIR OSCILLATIONS
See PLASMA WAVES

LANTHANUM 139 TARGET
Polarization of lanthanum nucleus by dynamic polarization method, 15:37898 (RA;JP;In Japanese)

LANTHANUM CHROMITES
See LANTHANUM OXIDES

LANTHANUM COMPOUNDS
See also LANTHANUM FLUORIDES
LANTHANUM OXIDES
Specific heat of $La_{2-x}Sr_xCuO_4$: Volume fraction of superconductivity; possible structural transition at 45K, 15:37980 (R;US)

LANTHANUM FLUORIDES
An anti-stokes vibronic line in the emission spectrum of LaF_3:Gd, 15:37176 (J;US)
Short-range order in the $Ca_{1-x}La_xF_{2+x}$ solid solution: 1:0:3 or 1:0:4 clusters?, 15:37171 (J;US)

LANTHANUM OXIDES
Filled-band model leading to supercurrents in La-Ba-Cu-O, 15:37269 (J;US)
Muon-spin-relaxation and neutron-scattering studies of magnetism in single-crystal $La_{1.94}Sr_{0.06}CuO_4$, 15:37268 (J;US)
Renormalization from density-functional theory to strong-coupling models for electronic states in Cu-O materials, 15:37985 (J;US)
Strontium-induced oxygen defect structure and hole doping in $La_{2-x}Sr_xCuO_4$ (B), 15:37260 (J;US)
Superconducting La_2CuO_{4+x} prepared by oxygenation at high pressure: A Raman scattering study, 15:37242 (R;US)
Superconductivity and oxygen ordering in $(Ca,Ba,La)Cu_3O_{7-\delta}$, 15:37276 (J;US)
The oxidative coupling of methane by lanthanum oxide catalysts: The influence of phase morphology on catalytic properties, 15:37350 (R;US)

LASER CAVITIES
Optimization and characterization of a high repetition rate, high intensity Nd:YLF regenerative amplifier, 15:37417 (J;US)

LASER FUSION REACTORS
Ion acoustic decay instabilities in laser pellet interactions, 15:38057 (BA;US)
Neutronics issues for starlight: An inertial confinement fusion reactor concept, 15:38251 (RA;US)

LASER MATERIALS
Optical damage in epoxy polymers by millisecond light pulses, 15:37304 (BA;US)
LASER MIRRORS
Large area laser conditioning of dielectric thin film mirrors, 15:38273 (R;US)
LASER RADIATION
Four-wave mixing of Nd^{3+}-doped crystals and glasses, 15:37324 (J;US)
Generating radially polarized beams interferometrically, 15:37419 (J;US)
Nonlinear theory of intense laser-plasma interactions, 15:38305 (J;US)
The utilization of high-intensity lasers, 15:37403 (R;FR;In French)
LASER TARGETS
Ablative Rayleigh-Taylor instability in three dimensions, 15:38093 (J;US)
Effect of barrier layers in burnthrough experiments with 351-nm laser illumination, 15:38306 (J;US)
Laser program overview, 15:38264 (RA;US)
Soft x-ray spectra of low-Z gases produced by laser irradiation of a high-pressure supersonic gas jet, 15:38076 (BA;US)
Target design, 15:38265 (RA;US)
Target materials development, 15:38267 (RA;US)
LASER-PRODUCED PLASMA
A micro-fabrication compatible wiggler design scalable to sub-millimeter periods, 15:38282 (BA;US)
Measurements of laser wavelength scaling ion acoustic decay instability and associated effects in laser-plasma interaction experiments: Final report, 15:38256 (R;US)
Nonlinear theory of intense laser-plasma interactions, 15:38305 (J;US)
Numerical simulation of collective ion acceleration in the laser controlled collective accelerator, 15:38280 (BA;US)
Propagation of high energy laser beams through metallic aerosols, 15:37416 (J;US)
Pulsed-laser evaporation technique for deposition of thin films: Physics and theoretical model, 15:37971 (J;US)
Soft x-ray spectra of low-Z gases produced by laser irradiation of a high-pressure supersonic gas jet, 15:38076 (BA;US)
Transverse modulational instability of collinear waves, 15:38304 (J;US)
Vacuum ultraviolet radiation from neon implosions, 15:38301 (BA;US)
LASERS
See also FREE ELECTRON LASERS
SOLID STATE LASERS
X-RAY LASERS
1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion: Proceedings, 15:37138 (R;US)
Applied optics, 15:37186 (R;FR;In French)
Excitation of atoms passing through a TEM_{00} Gaussian laser beam at relativistic velocities, 15:37415 (J;US)
Ion acoustic decay instabilities in laser pellet interactions, 15:38057 (BA;US)
Laser program overview, 15:38264 (RA;US)
LASERTRONS
An RF-driven lasertron, 15:37473 (RA;US)
LASL
Los Alamos climatology, 15:37570 (R;US)
LAWRENCE LIVERMORE LABORATORY
Tiger Team Assessment of the Lawrence Livermore National Laboratory, 15:36798 (R;US)
LAWS
See also NATIONAL ENVIRONMENTAL POLICY ACT
OCCUPATIONAL SAFETY AND HEALTH ACT
RESOURCE RECOVERY ACTS
Environmental regulatory update table, April 1990, 15:37014 (R;US)
Environmental regulatory update table, March 1990, 15:37013 (R;US)
Environmental regulatory update table, May 1990, 15:37015 (R;US)
LEAD 208
Excitation and photon decay of giant multipole resonances, 15:37880 (R;US)
LEAD 208 TARGET
Excitation and photon decay of giant multipole resonances, 15:37880 (R;US)
Models and theory for precompound angular distributions, 15:37909 (R;US)
Negative pion-nucleus elastic scattering at 30 and 50 MeV, 15:37860 (J;US)
Preequilibrium (p,n) reaction as a probe for the effective nucleon-nucleon interaction in multistep direct processes, 15:37863 (J;US)
LEAD COMPOUNDS
See also LEAD OXIDES
The effects of hydrolysis and additive conditions on the gel-to-ceramic conversion of sol-gel derived $PbTiO_3$, 15:37240 (R;US)
LEAD OXIDES
Selective electrocatalysis of anodic oxygen-transfer reactions at chemically modified, thin-film lead dioxide electrodes, 15:37235 (R;US)
In situ processing of textured superconducting thin film of Bi(-Pb)-Ca-Sr-Cu-O by excimer laser ablation, 15:37256 (J;US)
LENNARD-JONES POTENTIAL
Structure-energy correlation for grain boundaries in F.C.C. metals: I. boundaries on the (111) and (100) planes, 15:37721 (J;US)
LEP STORAGE RINGS
Calibration simulation. A calibration Monte-Carlo program for the OPAL jet chamber, 15:37511 (R;DE;In German)
Selected topics on B physics at Lep, 15:37772 (R;FR)
LEPTON-DEUTERON INTERACTIONS
See DEUTERIUM TARGET
LEPTONIC DECAY
Leptonic CP violation in leptoquark models, 15:37794 (R;CA)
LEPTONS
See also ELECTRONS
MUONS
NEUTRINOS
Dilepton and dihadron production in proton-nucleus collisions at 800 GeV, 15:37759 (R;US)
LET
Activation of oncogenes by radon progeny and x-rays, 15:37665 (R;US)
LEUKOPOIESIS
Isolation and radioprotective assays of tissue inhibitory factors, 15:37664 (R;CN;In Chinese)
LEVEL DENSITY
See ENERGY LEVELS
LEVEL SCHEMES
See ENERGY LEVELS
LIE GROUPS
Explicit construction of nontrivial elements for homotopy groups of classical Lie groups, 15:37995 (J;US)
LIGHT
See VISIBLE RADIATION
LIGHT BULBS
Maintaining optimum light output with a thermally conductive heat pipe, 15:37120 (R;US)
LIGHT GUIDES
See OPTICAL FIBERS
LIGHT WATER COOLED REACTORS
See WATER COOLED REACTORS
LIMESTONE
Geochemical criteria for reservoir quality variations in chalk from the North Sea, 15:36743 (R;DK)
Viscosity, electrical conductivity, and cesium volatility of ORNL [Oak Ridge National Laboratory] vitrified soils with limestone and sodium additives, 15:36785 (R;US)
LIMITERS
A carbon-carbon panel design concept for the inboard limiter of the Compact Ignition Tokamak (CIT), 15:38132 (RA;US)
Alignment of the TFTR bumper limiter, 15:38147 (RA;US)

Modeling of runaway electron damage for the design of tokamak plasma facing components, 15:38148 (RA;US)

LINACS
See LINEAR ACCELERATORS

LINEAR ACCELERATORS
See also CEBAF ACCELERATOR
KHARKOV LINAC
LINEAR COLLIDERS
ORSAY LINAC
STANFORD LINEAR COLLIDER
Analysis and modelling of improved accelerating cavities for the Recirculating Linear Accelerator (RLA), 15:37458 (R;US)
High current RF accelerator for FEL applications, 15:37556 (RA;US)
Model-based expert systems for linac computer controls, 15:37471 (RA;US)
Poisoning studies of an osmium-coated dispenser cathode, 15:37504 (J;US)
Requirements for longitudinal HOM damping in superconducting recirculating linacs, 15:37469 (RA;US)
The compact linear accelerator program at Sandia National Laboratories, 15:37446 (R;US)
The new injector design for the upgraded RADLAC-II linear accelerator, 15:37482 (RA;US)

LINEAR COLLIDERS
Acceleration
Design and fabrication studies of high gradient accelerating structures for the CERN linear collider (CLIC), 15:37477 (RA;US)
Beam Bending Magnets
Reverse bending magnets in a combined-function lattice for the CLIC (CERN Liner Collider) damping ring, 15:37448 (BA;US)
Beam Dynamics
Beam dynamics issues in linear colliders, 15:37462 (BA;US)
Beam Extraction
High repetition rate kickers for linear colliders, 15:37476 (RA;US)
Beam Injection
High repetition rate kickers for linear colliders, 15:37476 (RA;US)
Beam Monitors
A high resolution beam profile monitor using Bremsstrahlung, 15:37472 (RA;US)
Beam-Beam Interactions
Beam phenomena at the interaction point, 15:37452 (RA;US)
Cavity Resonators
High repetition rate kickers for linear colliders, 15:37476 (RA;US)
Short RF pulse propagation in a traveling wave structure, 15:37480 (RA;US)
Design
Design constraints for e^+-e^- supercolliders at energies of 0.5-2.0 TeV per linac, 15:37439 (RA;US)
Reverse bending magnets in a combined-function lattice for the CLIC (CERN Liner Collider) damping ring, 15:37448 (BA;US)
Superconducting RF for direct acceleration in TeV colliders, 15:37433 (RA;US)
The study of a CERN linear collider, CLIC, 15:37438 (RA;US)
Electron Spectra
Electron energy spectrum and maximum disruption angle under multi-photon bremsstrahlung, 15:37461 (BA;US)
Klystrons
A review of Gyroklystrons and a cost estimate for a Gyroklystron-driven supercollider, 15:37474 (RA;US)
Relativistic klystron research for linear colliders, 15:37475 (RA;US)
Transient analysis of multicavity klystrons, 15:37478 (RA;US)
Microwave Equipment
Design considerations of high peak power gyroklystrons for linear colliders, 15:37481 (RA;US)
Power Systems
An FEL power source for a TeV linear collider, 15:37483 (RA;US)
The use of a single source to drive a binary peak power multiplier, 15:37479 (RA;US)
Research Programs
Advanced accelerator R & D at LAL/ORSAY, 15:37434 (RA;US)
KEK plans for a linear collider R & D, 15:37437 (RA;US)
SLAC R & D toward a TeV linear collider, 15:37440 (RA;US)
Rf Systems
A review of Gyroklystrons and a cost estimate for a Gyroklystron-driven supercollider, 15:37474 (RA;US)
Design and fabrication studies of high gradient accelerating structures for the CERN linear collider (CLIC), 15:37477 (RA;US)
Superconducting Cavity Resonators
Does UHV annealing above 1100C as a final surface treatment reduce field emission loading in superconducting cavities, 15:37470 (RA;US)
Superconducting RF for direct acceleration in TeV colliders, 15:37433 (RA;US)
Test Facilities
Test accelerator for linear collider, 15:37449 (BA;US)

LINEAR ENERGY TRANSFER
See LET

LINEAR Z PINCH DEVICES
Diffusion-driven currents in a Z-pinch, 15:38051 (R;SE)
Extrap interchange stability, 15:38043 (R;SE)
Lower pinch radius limit in EXTRAP, 15:38050 (R;SE)
Upper pinch radius limit in EXTRAP, 15:38049 (R;SE)
Vacuum ultraviolet radiation from neon implosions, 15:38301 (BA;US)

LIQUID ASPHALT
See PETROLEUM RESIDUES

LIQUID METAL COOLANT
See LIQUID METALS

LIQUID METAL TEST FACILITIES
See TEST FACILITIES

LIQUID METAL-WATER REACTIONS
See MOLTEN METAL-WATER REACTIONS

LIQUID METALS
Trends in dish-Stirling solar receiver designs, 15:36859 (R;US)

LIQUID-PHASE SINTERING
See SINTERING

LIQUIDS
See also BLACK LIQUIDS
LIQUID METALS
Diffusion in supercooled liquids via normal mode analysis, 15:37364 (J;US)

LITHIUM 6 REACTIONS
Angular momentum dependent absorption in ^{6}Li scattering, 15:37853 (J;US)

LITHIUM 6 TARGET
Scattering of polarized protons from ^{6}Li at 200 MeV, 15:37855 (J;US)

LITHIUM 7
Late-time dissipation of primordial baryon-number fluctuations and nucleosynthesis, 15:37804 (J;US)

LITHIUM 7 TARGET
Zero-degree cross sections for the ^{7}Li(p,n)^{7}Be(g.s.+0.43-MeV) reaction in the energy range 80–795 MeV, 15:37858 (J;US)

LITHIUM 8
Measurement of the half-life of ^{8}Li, 15:37856 (J;US)

LITHIUM CHLORIDES
Non-random mixing and fast ion decoupling in lithium chloroborate superionic glasses: An ion dynamics computer simulation study, 15:37301 (BA;US)

LITHIUM FLUORIDES
Lithium ion beam experiments on PBFA II, 15:38283 (BA;US)

LITHIUM IODIDES
Enhanced ionic conductivity in composite electrolytes, 15:37307 (BA;US)

LITHIUM IONS
Lithium ion beam experiments on PBFA II, 15:38283 (BA;US)

LITHIUM OXIDES
Activation evaluation of fusion solid breeder materials, 15:38171 (RA;US)
Non-random mixing and fast ion decoupling in lithium chloroborate superionic glasses: An ion dynamics computer simulation study, 15:37301 (BA;US)
Tritium analysis of a water-cooled solid breeder blanket for ITER, 15:38121 (RA;US)

LITHIUM SILICATES
Compound formation and phase equilibria in the system Li_4SiO_4-$LiGaSiO_4$, 15:37170 (J;US)
Tritium analysis of a water-cooled solid breeder blanket for ITER, 15:38121 (RA;US)

LMFBR TYPE REACTORS
See also EBR-2 REACTOR

After-Heat Removal
Analysis of a DRACS [Direct Reactor Auxiliary Cooling System] test COMMIX validation, 15:36922 (R;US)
Simplified analysis of PRISM RVACS [Reactor Vessel Auxiliary Cooling System] performance without liner spill-over, 15:36914 (R;US)

C Codes
Analysis of a DRACS [Direct Reactor Auxiliary Cooling System] test COMMIX validation, 15:36922 (R;US)

Coordinated Research Programs
[Liquid metal reactor/fast breeder reactor research and development]: Foreign trip report, June 4, 1990–June 9, 1990, 15:36927 (R;US)

Fuel Assemblies
Forced-to-natural convection transition tests in parallel simulated liquid metal reactor fuel assemblies, 15:36915 (R;US)

Fuel Cans
Fuel/cladding compatibility in irradiated metallic fuel pins at elevated temperatures, 15:36920 (R;US)

Fuel Element Failure
Fuel damage during off-normal transients in metal-fueled fast reactors, 15:36959 (R;US)

Fuel Elements
Consequences of metallic fuel-cladding liquid phase attack during over-temperature transient on fuel element lifetime, 15:36919 (R;US)
Fuel damage during off-normal transients in metal-fueled fast reactors, 15:36959 (R;US)

Fuel Pins
Analysis of metal fuel transient overpower experiments with the SAS4A accident analysis code, 15:36918 (R;US)
Fuel motions in the multi-pin PFR/TREAT test series, 15:36953 (R;US)
Fuel/cladding compatibility in irradiated metallic fuel pins at elevated temperatures, 15:36920 (R;US)
Tomographic imaging of severely disrupted fuel assemblies tested in TREAT, 15:36916 (R;US)

Loss Of Coolant
Modeling developments for the SAS4A and SASSYS computer codes, 15:36921 (R;US)

Loss Of Flow
Performance of metal and oxide fuels during accidents in a large liquid metal cooled reactor, 15:36955 (R;US)

Meltdown
The AFDM [advanced fluid dynamics model] program: Scope and significance, 15:36926 (R;US)

Nuclear Fuels
Performance of metal and oxide fuels during accidents in a large liquid metal cooled reactor, 15:36955 (R;US)

Reactor Accidents
Fuel motions in the multi-pin PFR/TREAT test series, 15:36953 (R;US)
Recent developments in the CONTAIN-LMR code, 15:36987 (R;US)

Reactor Cooling Systems
Consequences of pipe ruptures in metal fueled, liquid metal cooled reactors, 15:36957 (R;US)
The passive response of the Integral Fast Reactor concept to the chilled inlet accident, 15:36962 (R;US)

Reactor Monitoring Systems
A measurement-based method for predicting margins and uncertainties for unprotected accidents in the Integral Fast Reactor concept, 15:36960 (R;US)
Quantitative studies of severe fuel damage using delayed neutron data, 15:36938 (R;US)

Risk Assessment
A measurement-based method for predicting margins and uncertainties for unprotected accidents in the Integral Fast Reactor concept, 15:36960 (R;US)

Seismic Effects
Joint US/Japanese program of full-size building tests for base seismic isolation, 15:36958 (R;US)

Transient Overpower Accidents
Performance of metal and oxide fuels during accidents in a large liquid metal cooled reactor, 15:36955 (R;US)

LOAD (DYNAMIC)
See DYNAMIC LOADS

LOAD MANAGEMENT
Utilization of off-peak electric power to improve cycle efficiency during peak demand periods, 15:36887 (R;US)

LOCA
See LOSS OF COOLANT

LOCKS (SECURITY)
See PHYSICAL PROTECTION DEVICES

LOFT REACTOR
An account of the OECD LOFT [Organization for Economic Co-operation and Development Loss-of-Fluid] Project, 15:36983 (R;US)
An account of the OECD LOFT [Organization for Economic Co-operation and Development Loss of Fluid Test] Project: Executive summary, 15:36984 (R;US)
Postirradiation examination results from the LP-FP-2 center fuel module, 15:36970 (R;US)
TRAC-PF1 MOD1 post test calculations of the OECD LOFT Experiment LP-SB-1, 15:36981 (R;US)
TRAC-PF1/MOD1 post-test calculations of the OECD LOFT Experiment LP-SB-3, 15:36982 (R;US)
The LP-FP-2 severe fuel damage scenario and discussion of the relative influence of the transient and reflood phases in affecting the final condition of the bundle, 15:36971 (R;US)

LONGITUDINAL PINCH DEVICES (LINEAR)
See LINEAR Z PINCH DEVICES

LOOPS (COOLANT)
See COOLANT LOOPS

LOS ALAMOS SCIENTIFIC LABORATORY
See LASL

LOSS OF COOLANT
Modeling developments for the SAS4A and SASSYS computer codes, 15:36921 (R;US)
Two dimensional LOCA (loss-of-coolant accident) analysis for fusion reactors, 15:38187 (RA;US)

LOSS OF FLUID TEST REACTOR
See LOFT REACTOR

LOW-LEVEL RADIOACTIVE WASTES
Handling, conditioning and disposal of spent sealed sources: Technical manual for the management of low and intermediate level wastes generated at small nuclear research centres and by radioisotope users in medicine, research and industry, 15:37937 (R;XA)
Sandia Sorption Data Management System, Version 2 (SSDMS II): User's manual, 15:36788 (R;US)
Testing methodologies, 15:37663 (R;US)
UNSAT-H Version 2.0: Unsaturated soil water and heat flow model, 15:36784 (R;US)
Viscosity, electrical conductivity, and cesium volatility of ORNL [Oak Ridge National Laboratory] vitrified soils with limestone and sodium additives, 15:36785 (R;US)
[Nuclear waste management]: Foreign trip report, October 6, 1988–November 6, 1988, 15:36781 (R;US)
[Waste immobilization technology]: Foreign trip report, March 16–April 8, 1988, 15:36780 (R;US)

LUBRICANTS
Assessment of fundamental materials needs for thick thermal barrier coatings (TTBC's) for truck diesel engines, 15:37230 (R;US)

LUMINOUS FLUX DENSITY
See ILLUMINANCE

LUTETIUM 176
Half-life of ^{176}Lu, 15:37879 (J;US)

LWR TYPE REACTORS
See WATER COOLED REACTORS
LYMPHOPOIESIS
See LEUKOPOIESIS
LYOPHILIZATION
Improved method for the direct labeling of antibodies with Tc-99m, 15:37647 (R;US)

M

MA 956
See IRON BASE ALLOYS
MACH-ZEHNDER INTERFEROMETER
Multi-layer film neutron interferometers, 15:37523 (RA;JP;In Japanese)
MAGNESIUM
Leaf magnesium alters photosynthetic response of low water potentials in sunflower, 15:37642 (J;US)
Magnesium atoms in an intense nonresonant laser field, 15:37732 (J;US)
Multiphoton ionization of magnesium with configuration-interaction calculations, 15:37735 (J;US)
MAGNESIUM 24 REACTIONS
Spin alignment and resonance behavior in the $^{24}Mg+^{24}Mg$ system, 15:37864 (J;US)
MAGNESIUM 24 TARGET
Additional evidence for fusion-fission in $^{32}S+^{24}Mg$ reactions: Division of excitation energy and spin in the fission fragments, 15:37862 (J;US)
Spin alignment and resonance behavior in the $^{24}Mg+^{24}Mg$ system, 15:37864 (J;US)
MAGNESIUM IONS
Identification of hydrogenlike and heliumlike transitions in the spectrum of laser-produced magnesium plasmas, 15:37414 (J;US)
MAGNESIUM OXIDES
Coarsening kinetics of the tetragonal phase in a manganesia-partially-stabilized zirconia, 15:37257 (J;US)
MAGNET COILS
Fast rise-time magnetic field coil study, 15:38286 (BA;US)
High field, single turn toroidal magnet technology demonstrator for ignitex, 15:38293 (BA;US)
IGNITEX experiment, 15:38294 (BA;US)
Nuclear radiation analysis of the IGNITEX experiment, 15:38295 (BA;US)
MAGNETIC BEARINGS
Materials research issues in superconducting levitation and suspension as applied to magnetic bearings, 15:37227 (R;US)
MAGNETIC BREMSSTRAHLUNG
See SYNCHROTRON RADIATION
MAGNETIC COILS
See MAGNET COILS
MAGNETIC CONFINEMENT
Nonlinear magneto-hydrodynamics: Progress report, January 1, 1989–June 30, 1990, 15:38021 (R;US)
Plasma properties: Annual report, January 1, 1989–December 31, 1989, 15:38023 (R;US)
Resistive MHD turbulence, 15:38019 (R;US)
MAGNETIC DISKS
Wear mechanisms of amorphous carbon and zirconia coatings on rigid disk magnetic recording media, 15:37241 (R;US)
MAGNETIC ENERGY STORAGE
Parametric design studies of toroidal magnetic energy storage units, 15:38258 (R;US)
MAGNETIC FIELDS
Hardware development and initial subassembly test of a gas-fired Stirling/Rankine residential heat pump, 15:37145 (R;US)
MAGNETIC MIRROR TYPE REACTORS
The mirrortron ion accelerator concept, 15:38064 (BA;US)
MAGNETIC SPECTROMETERS
See also FLAT MAGNETIC SPECTROMETERS
High resolution magnetic spectrograph 'Grand Raiden', 15:37532 (RA;JP;In Japanese)
MAGNETOACOUSTIC WAVES
Electron motion in a nonlinear magnetosonic wave propagating perpendicularly to a magnetic field, 15:38037 (R;JP)
MAGNETOHYDRODYNAMIC CHANNELS
See MHD CHANNELS
MAGNETOHYDRODYNAMICS
Compendium of MHD-related terminology, 15:37039 (R;US)
Self-similar statistics in MHD turbulence, 15:38026 (R;DE)
The electron energy distribution function of noble gases with flow, 15:38061 (BA;US)
Theoretical physics, 15:37989 (R;FR;In French)
MAGNETOSONIC WAVES
See MAGNETOACOUSTIC WAVES
MAGNETRONS
Theoretical study of stability analysis for relativistic planar magnetron, 15:38300 (BA;US)
MAGNETS
Coolants
Oil as an alternative coolant for use in the TFTR toroidal field coils, 15:38185 (RA;US)
Cooling
Liquid nitrogen cooling for the compact ignition tokamak, 15:38182 (RA;US)
Preliminary design of the CIT cryostat, 15:38183 (RA;US)
Current Density
A code for calculating force and temperature of a bitter plate type toroidal field coil system, 15:38176 (RA;US)
Design
Center conductor design for the compact Spherical Torus reactor, 15:38126 (RA;US)
Design and R and D for the central solenoid for the Compact Ignition Tokamak (CIT), 15:38096 (RA;US)
Electrothermal evaluation of conductors for the Compact Ignition Tokamak (CIT) PF coils, 15:38097 (RA;US)
Equilibrium shape control in CIT PF design, 15:38123 (RA;US)
Poloidal field coil system optimization for the Compact Ignition Tokamak (CIT), 15:38099 (RA;US)
Structural analysis of the toroidal field coils for the Compact Ignition Tokamak (CIT), 15:38218 (RA;US)
The CIT toroidal field coil and structure design and assembly approach, 15:38217 (RA;US)
Electric Conductivity
Coupled eddy current and thermodynamic analysis with the SPARK code, 15:38177 (RA;US)
Energy Storage
Vertical stability requirements for ARIES-1 reactor, 15:38145 (RA;US)
Mathematical Models
Coupled eddy current and thermodynamic analysis with the SPARK code, 15:38177 (RA;US)
Microstructure
Microstructure of melt spun Nd-Fe-Co-B magnets, 15:37209 (J;US)
Parametric Analysis
Electromechanical analysis of a prototype 20 TESLA, single turn toroidal field coil for IGNITEX, 15:38175 (RA;US)
Performance
Center conductor design for the compact Spherical Torus reactor, 15:38126 (RA;US)
Power Supplies
Analysis of the poloidal field system leads in the IGNITEX experiment, 15:38116 (RA;US)
DIII-D F-coil chopper selection, control and fault recognition system, 15:38229 (RA;US)
Plasma vertical stability and feedback control for CIT, 15:38146 (RA;US)
Preliminary power supply design for the TF coil system of CIT, 15:38189 (RA;US)
Quenching
Analysis of quench-vent pressures for present design of ITER [International Thermonuclear Experimental Reactor] TF [toroidal field] coils, 15:38100 (RA;US)

Research Programs
Design and R and D for the central solenoid for the Compact Ignition Tokamak (CIT), 15:38096 (RA;US)
Stresses
Analysis of the poloidal field system leads in the IGNITEX experiment, 15:38116 (RA;US)
Supports
Stress analysis of JT-60U tokamak, 15:38228 (RA;US)
Temperature Gradients
A code for calculating force and temperature of a bitter plate type toroidal field coil system, 15:38176 (RA;US)
Thermal Analysis
TFTR TF coil thermal analysis and test, 15:38186 (RA;US)
Transformers
Optimization of the poloidal transformer of ignitor, 15:38184 (RA;US)

MAHOGANY TREES
See TREES

MALES
Effects of a modified through-mask drinking system (MDS) on fluid intake during exercise in chemical protective gear. Report for January-May 1989, 15:37558 (R;US)

MALIGNANCIES
See NEOPLASMS

MAN
Immunological and biochemical effects of 60-Hz electric and magnetic fields in humans: Phase 3, Quarterly report No. 9, October 1–December 31, 1987, 15:37684 (R;US)
Immunological and biochemical effects of 60-Hz electric and magnetic fields in humans: Phase 3: Quarterly report No. 6, January 1–March 31, 1987, 15:37683 (R;US)

MANAGEMENT
See also DATA BASE MANAGEMENT
LOAD MANAGEMENT
NUCLEAR MATERIALS MANAGEMENT
PROGRAM MANAGEMENT
RESOURCE MANAGEMENT
WASTE MANAGEMENT
Management research, 15:38309 (R;FR;In French)

MANIPULATORS
Stiffness control of teleoperators with redundant, dissimilar kinematics, 15:37373 (R;US)

MARINE ECOSYSTEMS
See AQUATIC ECOSYSTEMS

MARINE VEHICLE ACCIDENTS
See ACCIDENTS

MARTENSITE
Twin boundaries, interfaces and modulated structures in martensites: Annual progress report No. 5, July 1, 1989–June 30, 1990, 15:37184 (R;US)

MASS FORMULAE
Trends in atomic mass studies and comparisons of masses, Q-values, etc. of unstable nuclei, 15:37904 (RA;JP;In Japanese)

MASS SPECTROMETERS
A Recoil Mass Spectrometer for the HHIRF [Holifield Heavy Ion Research Facility] facility, 15:37518 (R;US)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY ALCATOR
See ALCATOR DEVICE

MATERIALS
See also BIOLOGICAL MATERIALS
BUILDING MATERIALS
COMPOSITE MATERIALS
DIELECTRIC MATERIALS
ENVIRONMENTAL MATERIALS
FISSIONABLE MATERIALS
HAZARDOUS MATERIALS
ION EXCHANGE MATERIALS
LASER MATERIALS
PHASE CHANGE MATERIALS
POROUS MATERIALS
RADIOACTIVE MATERIALS
REACTOR MATERIALS
REINFORCED MATERIALS
SEMICONDUCTOR MATERIALS
THERMONUCLEAR REACTOR MATERIALS
Texture of materials by time-of-flight neutron diffraction, 15:37191 (R;US)
[Radiation materials science in the Soviet Union]: Foreign trip report, May 19–31, 1990, 15:37290 (R;US)

MATERIALS (ANTIFERROMAGNETIC)
See ANTIFERROMAGNETIC MATERIALS

MATERIALS (BIOLOGICAL)
See BIOLOGICAL MATERIALS

MATERIALS (BUILDING)
See BUILDING MATERIALS

MATERIALS (COMPOSITE)
See COMPOSITE MATERIALS

MATERIALS (DIELECTRIC)
See DIELECTRIC MATERIALS

MATERIALS (ENVIRONMENTAL)
See ENVIRONMENTAL MATERIALS

MATERIALS (FERROMAGNETIC)
See FERROMAGNETIC MATERIALS

MATERIALS (POROUS)
See POROUS MATERIALS

MATERIALS (REINFORCED)
See REINFORCED MATERIALS

MATERIALS (SEMICONDUCTOR)
See SEMICONDUCTOR MATERIALS

MATERIALS HANDLING
The use of cryopumps for impurity pumping during the TFTR D-T phase, 15:38138 (RA;US)

MATERIALS TESTING
Characteristics of the IAEA correlation monitor material for surveillance programmes, 15:37199 (R;FI)
Time-reversible equilibrium and nonequilibrium isothermal-isobaric simulations with centered-difference Stoermer algorithms, 15:37396 (J;US)

MATHEMATICS
See also STATISTICS
Applied mathematics, 15:37990 (R;FR;In French)
Computer animation in mathematics, science and art, 15:38340 (R;US)
Mathematics, 15:37991 (R;FR;In French)

MATRICES
An improved method for one-way dissection with singular diagonal blocks, 15:38330 (R;US)

MEASURED VALUES
See DATA

MEASURING INSTRUMENTS
See also CALORIMETERS
RADIATION DETECTORS
SPECTROMETERS
Electromagnetic compatibility of the machine measuring equipment in RFX experiment, 15:38230 (RA;US)
Hydroxyl radical concentration measurements in a turbulent flow reactor using a high temperature laser induced fluorescence probe, 15:37372 (BA;US)
Instrumental effects in surface finish measurement, 15:37537 (R;US)
Microsensor research, 15:37409 (R;US)

MECHANICAL STRUCTURES
See also BELLOWS
SUPPORTS
Solid state mechanics, 15:37162 (R;FR;In French)
Superstructure for a super tokamak: Alcator C-MOD, 15:38219 (RA;US)

MECHANICAL VIBRATIONS
A magnetically coupled Stirling engine driven heat pump: Design optimization and operating cost analysis, 15:37143 (R;US)

MEDICINES
See DRUGS

MELANOMAS
Improved method for the direct labeling of antibodies with Tc-99m, 15:37647 (R;US)

MELTDOWN
Heat transfer in reactor cavity during core-concrete interaction, 15:36909 (R;FR)

MEMBRANES
Membrane process designs in the recovery of bio-fuels and biochemicals, 15:37150 (R;US)
Membrane separation systems—A research and development needs assessment: Executive summary: Volume 1, 15:37147 (R;US)
Membrane separation systems—A research and development needs assessment: Final report: Volume 2, 15:37148 (R;US)
Membrane technology applications in the food industry: Present and future, 15:37151 (R;US)
The development and characterization of ion exchange membranes for selected electrochemical power sources, 15:37002 (R;US)
Thermal fluctuations and phase equilibrium in microemulsions, 15:37746 (J;US)

MERCAPTOALANINE-BETA
See CYSTEINE

MERCURY
Mercury-binding proteins in the slipper limpet, Crepidula fornicata, exposed to increased soluble mercury, 15:37682 (J;US)

MERCURY 194
Spin alignment in superdeformed Hg nuclei, 15:37883 (J;US)

MERCURY IODIDES
Improved yield of high resolution mercuric iodide gamma-ray spectrometers, 15:37517 (R;US)
Incorporation of defects during processing of mercuric iodide detectors, 15:37248 (J;US)

MESON FACTORIES
B-factories: A perspective of β-physics and possible accelerator design approaches, 15:37436 (RA;US)

MESON RESONANCES
See MESONS

MESON-DEUTERON INTERACTIONS
See DEUTERIUM TARGET

MESONS
New DM2 results on D/f_1(1285) and ι/η(1440), 15:37766 (R;FR)

METABOLITES
TNT [trinitrotoluene] metabolites in animal tissues: Quarterly technical progress report No. 6, January 1–March 31, 1990, 15:37676 (R;US)

METAGALAXY
See UNIVERSE

METAL-NONMETAL BATTERIES
Properties of electrolyte and electrode films prepared by rf and dc magnetron sputtering, 15:37247 (BA;US)

METAL-WATER REACTIONS
See MOLTEN METAL-WATER REACTIONS

METALS
See also ALUMINIUM
LIQUID METALS
MERCURY
SCRAP METALS
TRANSITION ELEMENTS
Metals and Ceramics Division progress report for period ending September 30, 1989, 15:37192 (R;US)

METHANE
Cloud albedo, greenhouse effects, atmospheric chemistry, and climate change, 15:37590 (J;US)
Laser spark ignition of laminar CH_4/air mixtures, 15:36753 (BA;US)
Mechanisms and controlling characteristics of the catalytic oxidation of methane: Final technical report, June 15, 1986–June 14, 1990, 15:37341 (R;US)
The greenhouse effect and acid rain: A tutorial, 15:37580 (R;US)
The oxidative coupling of methane by lanthanum oxide catalysts: The influence of phase morphology on catalytic properties, 15:37350 (R;US)
The role of purine degradation in methane biosynthesis and energy production in Methanococcus vannielii: Progress report, March 1, 1989–February 28, 1990, 15:37634 (R;US)

METHANOGENIC BACTERIA
Structure and regulation of methanogen genes: Progress report, July 1, 1987–June 30, 1989, 15:37630 (R;US)
The role of purine degradation in methane biosynthesis and energy production in Methanococcus vannielii: Progress report, March 1, 1989–February 28, 1990, 15:37634 (R;US)

METHANOL
Thermal decomposition of methanol in shock waves, 15:36823 (J;US)

METHANOL FUELS
Alternative transportation fuels: A tax and energy perspective, 15:36824 (BA;US)

METHYL ALCOHOL
See METHANOL

METHYL RADICALS
Infrared diode laser spectroscopy of the ν_3 fundamental of the CD_3 radical, 15:37338 (J;US)

METHYL-FUEL
See ALCOHOLS
METHANOL

MHD CHANNELS
Thermal instability in current-carrying plasmas, 15:38083 (BA;US)

MHD EQUILIBRIUM
Equilibrium shape control in CIT PF design, 15:38123 (RA;US)

MHD GENERATOR CFFF
Characterization of flow disturbances in a coal fired combustion flow train, 15:37040 (R;US)
EPA [Environmental Protection Agency] performance tests for particulate and SO_2 conducted at the DOE Coal-Fired Flow Facility, 15:37041 (R;US)

MICROANALYSIS
Development of a scanning proton microprobe - computer-control, elemental mapping and applications, 15:37333 (R;SE)

MICROBIAL FLORA
See MICROORGANISMS

MICRODOSIMETRY
The Pretoria cyclotron facility: Radiation physics, 15:37650 (RA;ZA)

MICROELECTRONICS
Microsensor research, 15:37409 (R;US)

MICROEMULSIONS
Thermal fluctuations and phase equilibrium in microemulsions, 15:37746 (J;US)

MICROFLORA
See MICROORGANISMS

MICROORGANISMS
See also BACTERIA
Detection and control of microbiologically influenced corrosion: An extension of the sourcebook for microbiologically influenced corrosion in nuclear power plants, 15:36935 (R;US)

MICROPROCESSORS
The Reason Project, 15:38334 (R;US)

MICROSPHERES
Bounds on the effective properties of polydispersed suspensions of spheres: An evaluation of two relevant morphological parameters, 15:37968 (J;US)

MICROWAVE AMPLIFIERS
Realization of cavity and drift space designs for a 30 MW, 10 GHz gyroklystron, 15:38069 (BA;US)

MICROWAVE EQUIPMENT
See also MICROWAVE AMPLIFIERS
MICROWAVE TUBES
SQUID DEVICES
Design considerations of high peak power gyroklystrons for linear colliders, 15:37481 (RA;US)

MICROWAVE RADIATION
Air breakdown in the relativistic limit, 15:38078 (BA;US)
Experimental design of spectroscopic measurements of microwave electric field in MTX tokamak plasma, 15:38079 (BA;US)
Phase-locking of multiple relativistic magnetrons, 15:38068 (BA;US)

MICROWAVE TUBES
See also KLYSTRONS
LASERTRONS
MAGNETRONS
The coaxial cavity locked HPM tube and external HPM feedback stabilization, 15:38290 (BA;US)
MIGRATION (RADIONUCLIDE)
See RADIONUCLIDE MIGRATION
MILITARY STRATEGY
Historical validation of an attrition model, 15:37546 (R;US)
Recent advances in analytic combat simulation: From modeling to validation and beyond, 15:37545 (R;US)
Scheduling Algorithm for Improving Lift (SAIL): Documentation for initial operating capability, 15:37547 (R;US)
MILL TAILINGS
Biological characterization of radiation exposure and dose estimates for inhaled uranium milling effluents: Final report, 15:36803 (R;US)
MINE-MOUTH GENERATING PLANTS
See FOSSIL-FUEL POWER PLANTS
MINERAL OIL
See LUBRICANTS
MIRRORS
See also LASER MIRRORS
Design and fabrication of high damage threshold turning mirrors for the Nova laser, 15:37244 (R;US)
Figure and finish of grazing incidence mirrors, 15:37280 (R;US)
MISGURNUS
See FISHES
MISSILES
Guidance and targeting for the strategic target system, 15:37557 (R;US)
MIXING
Chaotic mixing as a renormalization-group fixed point, 15:37743 (J;US)
MIXTURES
See also BINARY MIXTURES
SLURRIES
Theoretical studies of multicomponent mixtures: Phase equilibrium and transport: Progress report, September 1, 1988–May 15, 1990, 15:37282 (R;US)
MODELS (COSMOLOGICAL)
See COSMOLOGICAL MODELS
MODELS (PLASMA)
See PLASMA SIMULATION
MODES (OSCILLATION)
See OSCILLATION MODES
MOLECULAR BEAMS
Quantum optics, 15:37187 (R;FR;In French)
MOLECULAR CRYSTALS
Location of melting point at 300 K of nitrogen by Monte Carlo simulation, 15:37365 (J;US)
MOLECULAR ORBITAL MODEL
See MOLECULES
MOLECULE-MOLECULE COLLISIONS
Beuhler, Friedman, and Friedlander reply, 15:37849 (J;US)
Comment on "Cluster-impact fusion", 15:37848 (J;US)
MOLECULES
Tunneling of molecules in low-temperature media: An elementary description, 15:37737 (J;US)
[Multiphoton spectroscopy of molecules]: Foreign trip report, May 16, 1988–June 1, 1988, 15:37714 (R;US)
[Theoretical techniques for dynamics studies of polymers]: Foreign trip report, July 30–August 22, 1988, 15:37289 (R;US)
MOLTEN CARBONATE FUEL CELLS
Electrode reaction mechanisms in molten carbonate fuel cells: Final report, 15:37044 (R;US)
MOLTEN METAL-WATER REACTIONS
A mass transport model for hydrogen generation during lithium-lead/water interactions, 15:38172 (RA;US)
Behavior of radioactive species during water injection into alloy breeder material, 15:38173 (RA;US)
MOLYBDENUM
Dependence of H^- production upon the work function of a Mo surface in a cesiated hydrogen discharge, 15:37211 (J;US)
MOLYBDENUM ALLOYS
Metal/graphite - composites in fusion engineering, 15:38134 (RA;US)
MOLYBDENUM SULFIDES
Nature of the different nickel species in sulfided bulk and alumina-supported NiMo hydrotreating catalysts, 15:37215 (J;US)
MOMOTOMBO GEOTHERMAL FIELD
A geochemical study of the fluids in several wells: The Momotombo geothermal field, 15:36865 (R;FR;In French)
MONITORED RETRIEVABLE STORAGE
Nuclear waste: Is there a need for federal interim storage, 15:36783 (R;US)
MONITORS (REACTOR)
See REACTOR CONTROL SYSTEMS
MONOCLONAL ANTIBODIES
Improved method for the direct labeling of antibodies with Tc-99m, 15:37647 (R;US)
One step Tc-99m labeling of antibodies for use in inflammation imaging, 15:37646 (R;US)
SPECT [single photon emission computed tomography] assay of radiolabeled monoclonal antibodies: Progress report, September 1989–April 1990, 15:37645 (R;US)
[Radiopharmaceutical chemistry]: Foreign trip report, June 28–July 9, 1988, 15:37652 (R;US)
MONTE CARLO METHOD
Electron swarms in two phase plasmas, 15:38084 (BA;US)
MOTORS
Trends in dish-Stirling solar receiver designs, 15:36859 (R;US)
MOVING-BOUNDARY CONDITIONS
[International conference on free and moving boundary problems]: Foreign trip report, October 9, 1988–October 23, 1988, 15:38327 (R;US)
MULTI-NUCLEON TRANSFER REACTIONS
See also TWO-NUCLEON TRANSFER REACTIONS
Study of ^{19}N and ^{21}O by multinucleon transfer, 15:37850 (R;AU)
MULTICHARGED IONS
Excitation of atomic hydrogen by fully stripped ions, 15:37729 (J;US)
MULTIPROCESSING
See PARALLEL PROCESSING
MULTIPROCESSORS
See ARRAY PROCESSORS
MULTIWIRE DRIFT CHAMBERS
See DRIFT CHAMBERS
MULTIWIRE PROPORTIONAL CHAMBERS
See also DRIFT CHAMBERS
Low-mass, high-rate cylindrical MWPC's for the MEGA experiment, 15:37526 (R;US)
MUNITIONS
See ORDNANCE
MUONIC MOLECULES
Accurate alpha sticking fractions from improved calculations relevant for muon catalyzed fusion: Final report, 15:37709 (R;US)
MUONS
A search for $\mu \rightarrow e\gamma$ at the level of 10^{-13}, 15:37773 (R;US)
Nuclear dependence of dimuon production at 800 GeV, 15:37782 (J;US)
Physics study with muons, 15:37717 (RA;JP;In Japanese)
The experimental search for point sources above 1 TeV, 15:37699 (J;US)
MUSEUMS
See EDUCATIONAL FACILITIES
MWPC
See MULTIWIRE PROPORTIONAL CHAMBERS

N

NAC CYCLOTRON
Annual report June 1988, 15:37428 (R;ZA)
Annual report June 1989, 15:37429 (R;ZA)

Beam transport: Beam diagnostics for beamlines, 15:37490 (RA;ZA)
Experimental nuclear physics: Integral excitation functions for proton-induced reactions on Mn and Ni in the energy range 20-200 MeV, 15:37830 (RA;ZA)
Experimental nuclear physics: Model calculations for continuum yields induced by 200MeV protons on four different targets, 15:37851 (RA;ZA)
Mechanical engineering, 15:37441 (RA;ZA)
Radioisotope production, 15:37491 (RA;ZA)
Radioisotope production and radioactivity standards: Radioisotope production, 15:37496 (RA;ZA)
Radiotherapy and research in the biophysical sciences: Radiotherapy, 15:37651 (RA;ZA)
The injector cyclotrons, 15:37492 (RA;ZA)
The injector cyclotrons, 15:37489 (RA;ZA)

NACSSC
See NAC CYCLOTRON

NAPHTHALENE
Biexcitonic autoionization in naphthalene trimer clusters, 15:37313 (J;US)

NAPHTHENES
See CYCLOALKANES

NASA
Multimegawatt space power reactors, 15:36925 (R;US)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
See NASA

NATIONAL ENVIRONMENTAL POLICY ACT
Tiger Team Assessment of the Lawrence Livermore National Laboratory, 15:36798 (R;US)

NATIONAL GOVERNMENT
The federal government should do more to improve US energy efficiency, 15:37030 (R;US)

NATIONAL REACTOR TESTING STATION
See IDAHO NATIONAL ENGINEERING LABORATORY

NATURAL CIRCULATION
See NATURAL CONVECTION

NATURAL CONVECTION
A model for transient natural convection in a vertical cylinder with sidewall heating, 15:36720 (R;US)
Developing convection above a finite horizontal surface, 15:37388 (R;US)

NATURAL GAS INDUSTRY
Integration of the natural gas markets in Western Europe, 15:36745 (BA;US)
International Energy Statistical Review. Monthly report, 15:36732 (R;US)

NATURAL RUBBER
Proceedings of the international symposium on radiation vulcanization of natural rubber latex, 15:36817 (R;JP)

NAVAL OIL SHALE RESERVES
Naval Petroleum Reserve No. 3, Naval Oil Shale Reserves Nos. 1, 2, 3: Site environmental report, CY 1989, 15:37564 (R;US)

NAVAL PETROLEUM RESERVE
Naval Petroleum Reserve No. 3, Naval Oil Shale Reserves Nos. 1, 2, 3: Site environmental report, CY 1989, 15:37564 (R;US)

NEGATONS
See ELECTRONS

NEGATRONS
See ELECTRONS

NEODYMIUM 138
Deformation effects in the compound nucleus decay using the spin-alignment method, 15:37871 (J;US)

NEODYMIUM 144
Mixed-symmetry states in ^{144}Nd: Semimicroscopic accounting within the cluster vibration model and its mapping into the interacting boson model, 15:37914 (J;US)

NEODYMIUM ALLOYS
Microstructure of melt spun Nd-Fe-Co-B magnets, 15:37209 (J;US)

NEODYMIUM IONS
Four-wave mixing of Nd^{3+}-doped crystals and glasses, 15:37324 (J;US)

NEODYMIUM LASERS
Design and fabrication of high damage threshold turning mirrors for the Nova laser, 15:37244 (R;US)
Development of composite polymer-glass edge claddings for Nova Laser Disks, 15:37413 (BA;US)
Holographic interferometry of gas-puff Z-pinches, 15:38075 (BA;US)
Optimization and characterization of a high repetition rate, high intensity Nd:YLF regenerative amplifier, 15:37417 (J;US)
Oscillator and system development on the VULCAN glass laser system for the plasma beat-wave program, 15:37444 (R;GB)

NEON
Holographic interferometry of gas-puff Z-pinches, 15:38075 (BA;US)
Vacuum ultraviolet radiation from neon implosions, 15:38301 (BA;US)

NEOPLASMS
See also MELANOMAS
SARCOMAS
An accelerator neutron source for BNCT [Boron Neutron Capture Therapy]: Progress report, 15 July 1989–15 March 1990, 15:37644 (R;US)
Power Burst Facility/Boron Neutron Capture Therapy Program for Cancer Treatment: Monthly bulletin, Volume 4, No. 2, 15:37666 (R;US)
[Radiopharmaceutical chemistry]: Foreign trip report, June 28–July 9, 1988, 15:37652 (R;US)

NEPA
See NATIONAL ENVIRONMENTAL POLICY ACT

NEPTUNIUM ALLOYS
Elucidation of the specific-heat anomaly below T_N in $NpIr_2$, 15:37223 (J;US)

NEUROSPORA
Mechanisms and control of K^+ transport in plants and fungi, 15:37629 (R;US)

NEUTRAL ATOM BEAM INJECTION
Pumping of gaseous helium using argon frosted liquid helium cryo-condensation pumps, 15:38180 (RA;US)

NEUTRAL BEAM SOURCES
A comparison between hypervapotron and multitube high heat flux beam stopping elements, 15:38131 (RA;US)
A neutral particle beam system for ITER with rf acceleration, 15:38239 (RA;US)
Assessment of possible implications of a neutral beam configuration for CIT, 15:38149 (RA;US)
Beam current regulation of DIII-D neutral beam long pulse ion sources, 15:38142 (RA;US)
Beamline duct gas release conditioning and the upgraded duct wall protection system of the JET neutral injection, 15:38253 (RA;US)
Design and construction of the neutral beam injector for compact helical system (CHS), 15:38240 (RA;US)
Design of the ITER (International Thermonuclear Experimental Reactor) neutral beam system beamline, United States concept, 15:38238 (RA;US)
Effects of beam perveance to the performance characteristics of the electrically electron-suppressed beam direct converter with secondary electron suppressor grids, 15:38162 (RA;US)
Operation of JT-60NBI and NBI system for JT-60 upgrade, 15:38144 (RA;US)
PC-Link historical data base system MODCOMP/IBM at link for neutral particle beam operation, 15:38243 (RA;US)
TFTR neutral beam automated thermocouple monitor, 15:38246 (RA;US)
TFTR neutral beam bellows redesign and calorimeter upgrade, 15:38241 (RA;US)
The development of long pulse high voltage power supply for MNI-$_1$U neutral beam injector, 15:38206 (RA;US)

NEUTRINO DETECTION
Acceleration and propagation of cosmic rays. Production, oscillation and detection of neutrinos, 15:37691 (R;FR;In French)

NEUTRINOS
Neutrino counting at e^+e^- colliders, 15:37800 (J;US)

The experimental search for point sources above 1 TeV, 15:37699 (J;US)

NEUTRON BEAMS
Radiotherapy and research in the biophysical sciences: Biophysical research projects, 15:37669 (RA;ZA)
The Pretoria cyclotron facility: Radiation physics, 15:37650 (RA;ZA)

NEUTRON CAPTURE
See NEUTRON REACTIONS

NEUTRON DETECTORS
See also PROTON RECOIL DETECTORS
Two-dimensional position-sensitive detectors for small-angle neutron scattering, 15:37530 (R;US)

NEUTRON DIFFRACTION
Design of thick aperture for fine-resolution neutron penumbral imaging, 15:38271 (R;US)
Texture of materials by time-of-flight neutron diffraction, 15:37191 (R;US)

NEUTRON DOSIMETRY
Clinical neutron dosimetry: Part 1, Determination of absorbed dose in a patient treated by external beams of fast neutrons, 15:37938 (R;US)
Research and calibration projects: Dosimetry intercomparisons, 15:37528 (RA;ZA)
[Radiation protection]: Foreign trip report, April 8–16, 1988, 15:37670 (R;US)

NEUTRON FLUENCE
Parameter and fluence-rate covariances in lepricon, 15:36911 (R;US)

NEUTRON MATTER
See NUCLEAR MATTER

NEUTRON REACTIONS
$^{12}C(n,\gamma_0)^{13}C$ cross section in the 8–11 MeV region, 15:37859 (J;US)
Analyzing power measurements for elastic scattering of 17 MeV neutrons from ^{120}Sn, 15:37872 (J;US)
Nuclear Ramsauer effect and the isovector potential, 15:37920 (J;US)

NEUTRON SOURCES
Advanced Neutron Source (ANS) Project progress report, 15:36818 (R;US)
Generation of spallation neutrons, 15:37929 (RA;JP;In Japanese)
Installation and performance tests of KUR cold neutron source, 1: Structure and safety design, 15:36948 (RA;JP;In Japanese)
Proposed neutron activation analysis facilities in the Advanced Neutron Source, 15:36945 (R;US)
Shield for UTS, 15:37930 (RA;JP;In Japanese)
The advanced neutron source reactor: An overview, 15:36816 (R;US)

NEUTRON THERAPY
Biophysical sciences: Physical characteristics of the neutron therapy unit, 15:37649 (RA;ZA)
Radiotherapy and research in the biophysical sciences: Biophysical research projects, 15:37669 (RA;ZA)
Radiotherapy and research in the biophysical sciences: Radiotherapy, 15:37651 (RA;ZA)
The Pretoria cyclotron facility: Radiobiology, 15:37668 (RA;ZA)

NEUTRON TRANSPORT
Calculation of neutron and γ production and transport for the Alcator C-Mod experiment, 15:38119 (RA;US)

NEUTRON TRANSPORT THEORY
McSUB, a Monte Carlo Library for neutron transport in two different media for the neutron energy range 0.1-20 MeV, 15:37923 (R;SE)
One-speed neutron transport eigenvalues for reflected slabs and spheres, 15:37921 (R;SE)
Study of the multiple scattering effect in TEBENE using the Monte Carlo method, 15:37922 (R;SE)

NEUTRONS
See also COLD NEUTRONS
EPITHERMAL NEUTRONS
FAST NEUTRONS
THERMAL NEUTRONS
Experiment of measuring neutron life, 15:37926 (RA;JP;In Japanese)
Interference experiment and analysis of neutron wave packet, 15:37925 (RA;JP;In Japanese)
Radiotherapy and research in the biophysical sciences: Biophysical research projects, 15:37669 (RA;ZA)
The Pretoria cyclotron facility: Radiobiology, 15:37668 (RA;ZA)
[International conference on radiation shielding]: Foreign trip report, September 11–16, 1988, 15:37931 (R;US)

NEVADA TEST SITE
Onsite environmental report for the Nevada Test Site, January 1988–December 1988, 15:37567 (R;US)

NICKEL
Nanoindentation study of the mechanical properties of copper-nickel multilayered thin films, 15:37205 (J;US)
New measurements of the elastic properties of composition modulated Cu-Ni thin films, 15:37207 (J;US)
Recombination and dissociation of H_2^+ and H_3^+ ions on surfaces to form $H_2(v'')$: Negative-ion formation on low-work-function surfaces, 15:37736 (J;US)

NICKEL 56
Additional evidence for fusion-fission in $^{32}S+^{24}Mg$ reactions: Division of excitation energy and spin in the fission fragments, 15:37862 (J;US)

NICKEL 58 TARGET
Reaction $^{58}Ni(\pi^+,pp)$ at T_{π^+}=160 MeV, 15:37866 (J;US)

NICKEL 60
Analysis of pion scattering to stretched states in ^{60}Ni and other nuclei using Woods-Saxon wave functions, 15:37854 (J;US)

NICKEL 60 TARGET
Analysis of pion scattering to stretched states in ^{60}Ni and other nuclei using Woods-Saxon wave functions, 15:37854 (J;US)

NICKEL ALLOYS
Center conductor design for the compact Spherical Torus reactor, 15:38126 (RA;US)

NICKEL IONS
Electron-impact ionization data for the nickel isonuclear sequence, 15:37715 (R;US)

NICKEL OXIDES
Synthesis and properties of $NdNiO_3$ prepared by low-temperature methods, 15:37166 (J;US)

NIOBIUM 93 TARGET
Models and theory for precompound angular distributions, 15:37909 (R;US)
Multinucleon transfer reactions for the $^{50}Ti+^{93}Nb$ system at sub- and near-barrier energies, 15:37869 (R;US)

NIOBIUM ALLOYS
Electrothermal evaluation of conductors for the Compact Ignition Tokamak (CIT) PF coils, 15:38097 (RA;US)
Moisture-induced embrittlement of Fe_3Al, 15:36690 (R;US)

NIOBIUM COMPOUNDS
See also NIOBIUM NITRIDES
Characterization of the strength and microstructural evolution of a heavily cold rolled Cu-20% Nb composite, 15:37254 (J;US)

NIOBIUM NITRIDES
Lorentz-force independence of resistance tails in magnetic fields near T_c for the low-temperature superconductor granular NbN: A Josephson-junction model, 15:37279 (J;US)

NITRATES
New selective anion-exchange resins for nitrate removal from contaminated drinking water and studies on analytical anion-exchange chromatography, 15:37616 (R;US)

NITRIC OXIDE
[Multiphoton spectroscopy of molecules]: Foreign trip report, May 16, 1988–June 1, 1988, 15:37714 (R;US)

NITROGEN
Estimating nitrogen lost from forest floor during prescribed fires in Douglas-fir/western hemlock clearcuts, 15:37607 (J;US)
Location of melting point at 300 K of nitrogen by Monte Carlo simulation, 15:37365 (J;US)
Turbulence studies of high pressure dynamic nitrogen arcs, 15:38059 (BA;US)
[Workshop on artificially ionized layers in the atmosphere]: Foreign trip report, October 5–14, 1989, 15:37568 (R;US)

NITROGEN 19
Study of ^{19}N and ^{21}O by multinucleon transfer, 15:37850 (R;AU)
NITROGEN DIOXIDE
Changes in terrestrial ecosystems after long-term exposure to airborne pollutants - studies on the effects of ozone and NO_x immissions on spontaneous vegetation. Final report, 15:37681 (R;DE;In German)
NITROGEN IONS
Binary-encounter electrons observed at 0° in collisions of 1–2-MeV/amu H^+, C^{6+}, N^{7+}, O^{8+}, and F^{9+} ions with H_2 and He targets, 15:37728 (J;US)
NITROGEN NITRIDES
See NITROGEN
NITROGEN OXIDES
See also NITRIC OXIDE
NITROGEN DIOXIDE
NITROUS OXIDE
An investigation to define the physical/chemical constraints which limit NO_x emission reduction achievable by reburning: Final report, 15:36708 (R;US)
Cloud albedo, greenhouse effects, atmospheric chemistry, and climate change, 15:37590 (J;US)
Combined nitrogen oxides/sulfur dioxide control in a spray-dryer/fabric-filter system: Summary report for the Field Research Program, 15:36895 (R;US)
Combined nitrogen oxides/sulfur dioxide control in dry scrubber systems: Volume 2, Evaluation of additives and process modifications: Appendixes, 15:36894 (R;US)
Toward more realistic material models for release and dispersion of heavy gases, 15:37587 (R;US)
Use of ferrous chelates for NO_x control in aqueous scrubbers, 15:36707 (R;US)
NITROSAMINES
Biological (molecular and cellular) markers of toxicity: Semi-annual technical progress report No. 3, October 1, 1989–March 31, 1990, 15:37677 (R;US)
NITROUS OXIDE
Cloud albedo, greenhouse effects, atmospheric chemistry, and climate change, 15:37590 (J;US)
The greenhouse effect and acid rain: A tutorial, 15:37580 (R;US)
NOISE
Electromagnetic compatibility of the machine measuring equipment in RFX experiment, 15:38230 (RA;US)
NON-DISPERSIVE ION WAVES
See ION ACOUSTIC WAVES
NON-EQUILIBRIUM PLASMA
Including electron-electron collisions in Monte Carlo simulations of swarms in partially ionized plasmas, 15:38298 (BA;US)
NON-PROLIFERATION TREATY
Bilateral agreements providing negative security assurances to states party to the Nuclear Non-Proliferation Treaty, 15:37161 (R;US)
Country statements on the nuclear non-proliferation treaty, Article 6, 15:37160 (R;US)
NONAXIAL NUCLEI
See DEFORMED NUCLEI
NONLINEAR PROBLEMS
Nonlinear elastic wave interactions in rock, 15:37287 (R;US)
NONLINEAR SYSTEMS
See NONLINEAR PROBLEMS
NOVA FACILITY
Development of composite polymer-glass edge claddings for Nova Laser Disks, 15:37413 (BA;US)
Gated microchannel plate detector (Engineering Materials), 15:37512 (E;US)
Nova experiments, 15:38266 (RA;US)
Optical damage in epoxy polymers by millisecond light pulses, 15:37304 (BA;US)
NRTS
See IDAHO NATIONAL ENGINEERING LABORATORY
NUCLEAR ACCIDENTS
See ACCIDENTS
NUCLEAR CONTESTATION
See PUBLIC RELATIONS
NUCLEAR CONTROVERSY
See HUMAN POPULATIONS
NUCLEAR DATA COLLECTIONS
[Cooperative research in the area of nuclear physics]: Foreign trip report, May 13–June 12, 1988, 15:37837 (R;US)
NUCLEAR ENERGY
Basic energy sciences: Summary of accomplishments, 15:37022 (R;US)
NUCLEAR FACILITIES
See also ISOTOPE SEPARATION PLANTS
NUCLEAR POWER PLANTS
RADIOACTIVE WASTE FACILITIES
Comprehensive Self-Assessment and Upgrade Program (CSAUP) performance objectives and criteria, 15:36806 (R;US)
DOE/NE University Program in robotics for advanced reactors: Program plan, FY 1990–FY 1994, 15:37375 (R;US)
EXPAC [EXPlosion Analysis Code] user's manual: A computer code for analyzing explosion-induced flow and material transport in nuclear facilities, 15:36802 (R;US)
NRC TLD [thermoluminescent dosimeter] Direct Radiation Monitoring Network: Progress report, January–March 1990: Volume 10, No. 1, 15:36973 (R;US)
Redundant and independent containment and surveillance systems, 15:36814 (R;US)
Transactions of the criticality alarm systems workshop, 15:36801 (R;US)
NUCLEAR FUEL ELEMENTS
See FUEL ELEMENTS
NUCLEAR FUELS
See also SPENT FUELS
[Advanced technologies for water-cooled reactors]: Foreign trip report, May 24–June 12, 1988, 15:36985 (R;US)
[Nuclear power engineering in space]: Foreign trip report, May 11, 1990–June 3, 1990, 15:36932 (R;US)
NUCLEAR MATERIALS MANAGEMENT
International safeguards: Accounting for nuclear materials, 15:36809 (R;US)
Safeguards training course: Nuclear material safeguards for enrichment plants: Part 4, Gas centrifuge enrichment plant: Diversion scenarios and safeguards activities, 15:36812 (R;US)
Safeguards training course: Nuclear material safeguards for enrichment plants: Part 3, Uranium enrichment plant: Description, material control and accountability procedures, and safeguards, 15:36811 (R;US)
Transportation of nuclear materials: A concern for local governments, 15:36808 (BA;US)
NUCLEAR MATTER
Uncertainties in the two-nucleon potential and nuclear matter predictions, 15:37913 (J;US)
NUCLEAR PHYSICS
Physics Division progress report for period ending September 30, 1989, 15:37836 (R;US)
NUCLEAR POWER PLANTS
Advancements in the behavioral modeling of fuel elements and related structures, 15:36997 (BA;US)
Annual radiological environmental monitoring report, Watts Bar Nuclear Plant, 1989, 15:37581 (R;US)
Annual radiological environmental operating report, Browns Ferry Nuclear Plant, 1989, 15:37582 (R;US)
Annual radiological environmental operating report, Sequoyah Nuclear Plant, 1989, 15:37583 (R;US)
DOE/NE University Program in robotics for advanced reactors: Program plan, FY 1990–FY 1994, 15:37375 (R;US)
Detection and control of microbiologically influenced corrosion: An extension of the sourcebook for microbiologically influenced corrosion in nuclear power plants, 15:36935 (R;US)
Eddy current inspection at the nuclear power plants, 15:37395 (R;FI;In Finnish)
Filtered vented containments, 15:36977 (RA;US)
Heat transfer between stratified liquids with bubbling across the interface, 15:37392 (R;US)
Human factors issues associated with advanced instrumentation and controls technologies in nuclear plants, 15:36939 (R;US)

Integrated Reliability and Risk Analysis System (IRRAS) Version 2.0 user's guide, 15:36980 (R;US)
Nondestructive evaluation research progress in 1989: Proceedings from the tenth annual EPRI NDE information meeting, 15:36934 (R;US)
Risk-based inspection guidelines, 15:36943 (J;US)
[Passive monitoring of nuclear systems]: Foreign trip report, May 18–30, 1988, 15:36940 (R;US)

NUCLEAR POWER STATIONS
See NUCLEAR POWER PLANTS

NUCLEAR REACTIONS
See also BREAKUP REACTIONS
HEAVY ION FUSION REACTIONS
INCOMPLETE FUSION REACTIONS
PHOTONUCLEAR REACTIONS
THERMONUCLEAR REACTIONS
Nuclear reactions and structure: Charged-particle induced reactions, 15:37835 (RA;ZA)
Nuclear reactions and structure: Reactions and techniques involving fast neutrons, 15:37834 (RA;ZA)

NUCLEAR SAFETY
See RADIATION PROTECTION

NUCLEAR STRUCTURE
Proceedings of the workshop on nuclear structure by gamma spectroscopy, 15:37908 (R;JP;In Japanese)

NUCLEAR THEORY
Research in theoretical nuclear physics: Progress report, 15:37893 (R;US)

NUCLEAR WASTES
See RADIOACTIVE WASTES

NUCLEI
See also DEFORMED NUCLEI
HYPERNUCLEI
INTERMEDIATE MASS NUCLEI
Neutron-Antineutron oscillations in nuclei, 15:37787 (R;FR)

NUCLEOGENESIS
See NUCLEOSYNTHESIS

NUCLEON-NUCLEON INTERACTIONS
Inelastic events in nucleon-nucleon scattering experiments, 15:37890 (R;FR;In French)
Lectures from the workshop on nucleon-nucleon bremsstrahlung, January 25–26, 1990, 15:37763 (R;US)
Relativistic effects in low-energy nucleon-nucleon scattering, 15:37910 (J;US)

NUCLEONS
See also NEUTRONS
PROTONS
Tensor coupling of the ρ meson in a chiral confining model, 15:37803 (J;US)

NUCLEOSYNTHESIS
See also THERMONUCLEAR REACTIONS
Late-time dissipation of primordial baryon-number fluctuations and nucleosynthesis, 15:37804 (J;US)

NUTS (MECHANICAL)
See FASTENERS

O

OAK RIDGE NATIONAL LABORATORY
See ORNL

OAKS
Ontogenetic patterns of CO_2 exchange of Quercus rubra L. leaves during three flushes of shoot growth I. median flush leaves, 15:37656 (J;US)
Ontogenetic patterns of CO_2 exchange of Quercus rubra L. leaves during three flushes of shoot growth II. insertion gradients of leaf photosynthesis, 15:37657 (J;US)

OBE MODEL
Relativistic effects in low-energy nucleon-nucleon scattering, 15:37910 (J;US)

OCCLUSION COMPLEXES
See CLATHRATES

OCCUPATIONAL EXPOSURE
Internal dosimetry and control, 15:37667 (R;US)
Radiation safety management during a TFTR shutdown, 15:38249 (RA;US)

OCCUPATIONAL SAFETY AND HEALTH ACT
Tiger Team Assessment of the Lawrence Livermore National Laboratory, 15:36798 (R;US)

OHMIC RESISTANCE
See ELECTRIC CONDUCTIVITY

OIL RESIDUES
See PETROLEUM RESIDUES

OIL SHALE WASTE WATER
See OIL SHALES
WASTE WATER

OIL SHALES
Ammonia evolution from western and eastern oil shales, 15:36757 (J;US)
Study of eastern and weatern oil shale minerals activity for hydrodesulfurization (HDS) and hydrodenitrogenaton (HDN) reactions, 15:36755 (J;US)
Thermal decomposition of DOE reference oil shales, 15:36758 (J;US)

OLEFINS
See ALKENES

OMEGA-1778 RESONANCES
See MESONS

ONCOGENES
Activation of oncogenes by radon progeny and x-rays, 15:37665 (R;US)

ONE-BOSON-EXCHANGE MODEL
See OBE MODEL

OPTICAL EQUIPMENT
Instrumental effects in surface finish measurement, 15:37537 (R;US)
Soliton switch using birefringent optical fibers, 15:37540 (J;US)

OPTICAL FIBERS
Applied optics, 15:37186 (R;FR;In French)
Soliton switch using birefringent optical fibers, 15:37540 (J;US)
Stimulated Raman scattering in optical fibers: Polychromatic single-field numerical experiments, 15:37954 (R;US)

OPTICAL PROPERTIES
Figure and finish of grazing incidence mirrors, 15:37280 (R;US)

OPTICALLY THICK PLASMA
The coaxial cavity locked HPM tube and external HPM feedback stabilization, 15:38290 (BA;US)

OPTICS
Workshop on high heat load x-ray optics, 15:37707 (R;US)

ORANGE-TYPE SPECTROMETERS
See FLAT MAGNETIC SPECTROMETERS

ORDNANCE
An evaluation of the environmental fate and behavior of munitions materiel (TNT, RDX) in soil and plant systems: Environmental fate and behavior of TNT [trinitrotoluene]: Final report, 15:37687 (R;US)
Johnston Atoll Chemical Agent Disposal System (JACADS) Final Second Supplemental Environmental Impact Statement (SSEIS): Volume 2, Comments received from the public and agencies on the Draft Second Supplemental Environmental Impact Statement (SSEIS), 15:37618 (R;US)
Johnston Atoll Chemical Agent Disposal System (JACADS): Volume 1, Final Second Supplemental Environmental Impact Statement (SSEIS) for the storage and ultimate disposal of the European chemical munition stockpile, 15:37617 (R;US)

ORGANIC CHLORINE COMPOUNDS
See also CHLORINATED ALIPHATIC HYDROCARBONS
CHLORINATED AROMATIC HYDROCARBONS
The greenhouse effect and acid rain: A tutorial, 15:37580 (R;US)
Uncertainty in exposure and health-risk assessment: An integrated approach, 15:37623 (R;US)

ORGANIC COMPOUNDS
See also AMINES
AROMATICS
ESTERS
HYDROCARBONS

ORGANIC NITROGEN COMPOUNDS
ORGANIC PHOSPHORUS COMPOUNDS
ORGANIC POLYMERS
PROTEINS
Adsorption and electrooxidation of some simple organic molecules on rhodium(111) as probed by real-time FTIR spectroscopy: Comparisons with platinum(111), 15:37219 (J;US)
Membrane process designs in the recovery of bio-fuels and biochemicals, 15:37150 (R;US)
Organic synthesis, 15:37346 (R;FR;In French)
Structure-energy correlation of the intramolecular charge-transfer state in a series of (N,N-diethylanilino) arenes, 15:37339 (J;US)
Studies of thermodynamic non-ideality effects on chemical equilibrium and oxidation reactions in supercritical fluids, 15:36741 (BA;US)
Technology evaluation report: SITE program demonstration of the Ultrox International ultraviolet radiation/oxidation technology, 15:37619 (R;US)

ORGANIC NITROGEN COMPOUNDS
See also AMIDES
PORPHYRINS
Factors controlling decomposition in arctic tundra and related root mycorrhizal processes: [Progress report], 15:37635 (R;US)

ORGANIC PHOSPHORUS COMPOUNDS
The irradiation effects on extraction properties and physical data of 30% TRPO-kerosene, 15:37367 (R;CN;In Chinese)

ORGANIC POLYMERS
Use of ferrous chelates for NO_x control in aqueous scrubbers, 15:36707 (R;US)

ORGANIC SOLAR CELLS
Photovoltaic conversion through thin films organic semiconductors, 15:36834 (R;FR;In French)

ORNL
Analytical Chemistry Division annual progress report for period ending December 31, 1989, 15:37334 (R;US)
Chemical Technology Division progress report for the period July 1, 1988 to September 30, 1989, 15:37327 (R;US)
Emergency preparedness at Oak Ridge National Laboratory, Oak Ridge, Tennessee, 15:36796 (R;US)
International aspects of Oak Ridge National Laboratory, 15:37024 (R;US)
Metals and Ceramics Division progress report for period ending September 30, 1989, 15:37192 (R;US)

ORPHEE REACTOR
Taking into account a reactivity accident in research reactors design, 15:36951 (R;FR;In French)

ORSAY LINAC
LAL contributions to the 1st EPAC conference, 15:37427 (R;FR)

OSCILLATION MODES
Observation of molecular vibrations in the time domain with incoherent laser pulses, 15:37541 (J;US)

OSCILLATIONS (PLASMA)
See PLASMA WAVES

OSCILLATORS
A sixteenth harmonic cusptron oscillator, 15:38071 (BA;US)

OSMIUM 174
High spin states and intrinsic structure in ^{174}Os and ^{175}Os - alignments and strong interaction, 15:37874 (R;AU)

OSMIUM 175
High spin states and intrinsic structure in ^{174}Os and ^{175}Os - alignments and strong interaction, 15:37874 (R;AU)

OSMIUM 180
Conversion coefficients and yrast state spins in ^{180}Os, 15:37875 (R;AU)
Lifetimes of high spin states in ^{181}Ir and ^{180}Os, 15:37878 (J;US)

OXIRANS
See EPOXIDES

OXYGEN
Electrode reaction mechanisms in molten carbonate fuel cells: Final report, 15:37044 (R;US)
Evidence for hole injection from $O_2(^1\Delta)$ into p-Si, 15:37178 (J;US)
Growth of parametric fields in (2+1)-photon laser ionization of atomic oxygen, 15:37730 (J;US)
Monte Carlo study of tracer and chemical diffusion of oxygen in $YBa_2Cu_3O_{6+2c}$, 15:37273 (J;US)
The intramolecular kinetic isotope effect for the reaction $O(^3P)$+HD, 15:37363 (J;US)

OXYGEN 16
Angular momentum dependent absorption in ^6Li scattering, 15:37853 (J;US)
Effective interactions and nuclear structure using 180 MeV protons. I. $^{16}O(p,p')$, 15:37857 (J;US)

OXYGEN 16 REACTIONS
Experimental results concerning global observables from the CERN SPS heavy ion program, 15:37752 (R;US)
Thermal and angular momentum effects in the giant-dipole-resonance decay of hot rare-earth nuclei, 15:37877 (J;US)

OXYGEN 16 TARGET
Angular momentum dependent absorption in ^6Li scattering, 15:37853 (J;US)
Effective interactions and nuclear structure using 180 MeV protons. I. $^{16}O(p,p')$, 15:37857 (J;US)

OXYGEN 17 REACTIONS
Excitation and fission decay of ^{238}U using the $(^{17}O,^{17}O')$ reaction, 15:37889 (J;US)

OXYGEN 21
Study of ^{19}N and ^{21}O by multinucleon transfer, 15:37850 (R;AU)

OXYGEN EFFECT (RADIOBIOLOGY)
See OXYGEN

OXYGEN HYDRIDES
See WATER

OXYGEN IONS
Binary-encounter electrons observed at 0° in collisions of 1–2-MeV/amu H^+, C^{6+}, N^{7+}, O^{8+}, and F^{9+} ions with H_2 and He targets, 15:37728 (J;US)

OZONE
Changes in terrestrial ecosystems after long-term exposure to airborne pollutants - studies on the effects of ozone and NO_x immissions on spontaneous vegetation. Final report, 15:37681 (R;DE;In German)
Sixth annual Gatlinburg acid rain conference: Proceedings, 15:37679 (R;US)

P

P CODES
How to evaluate a building from short-term tests, 15:37132 (BA;US)

P INVARIANCE
Some issues in elementary particle physics involving low-energy neutrons and antiprotons focusing on measurement of violated symmetry, 15:37792 (RA;JP;In Japanese)

PACIFIC GAS DIABLO CANYON-1 REACTOR
See DIABLO CANYON-1 REACTOR

PACIFIC GAS DIABLO CANYON-2 REACTOR
See DIABLO CANYON-2 REACTOR

PACIFIC NORTHWEST REGION
See FEDERAL REGION X

PALLADIUM
Mechanisms and controlling characteristics of the catalytic oxidation of methane: Final technical report, June 15, 1986–June 14, 1990, 15:37341 (R;US)

PALLADIUM BASE ALLOYS
Enhanced ordering and stability of Pd_8W in proton irradiated Pd-W alloys, 15:37206 (J;US)

PALLADIUM COMPLEXES
Transition metal mediated transformations of small molecules: Annual progress report, December 1, 1989–November 30, 1990, 15:37340 (R;US)

PAPER INDUSTRY
Research on droplet formation for application to kraft black liquors—Final project report: Technical report No. 5, 15:37146 (R;US)

PARAFFIN
Analysis of wallboard containing a phase change material, 15:37116 (R;US)

Conventional wallboard with latent heat storage for passive solar applications, 15:37117 (R;US)

PARAFFINS
See ALKANES

PARALLEL PROCESSING
Parallel programming with algorithmic skeletons, 15:38315 (R;US)

PARITY NONCONSERVATION
See P INVARIANCE

PARTICLE BEAM FUSION ACCELERATOR
See also ELECTRON BEAM FUSION ACCELERATOR
A laser-produced lithium ion source for pulsed-power inertial confinement fusion, 15:38261 (R;US)
Development of a laser diagnostic system at PBFA II for light-ion-beam research, 15:38088 (BA;US)
Lithium ion beam experiments on PBFA II, 15:38283 (BA;US)
New diagnostic developments for intense ion beam measurements on PBFA-2, 15:38040 (R;US)
Progress in 3D particle-in-cell modeling of heavy ion beam transport in quadrupole focusing channels, 15:38067 (BA;US)

PARTICLE PRODUCTION
Nuclear-structure effects in proton evaporation spectra, 15:37865 (J;US)

PARTICLES
See also PARTICULATES
A finite, rational model for the EPR-Bohm experiment, 15:37812 (R;US)
Diffusion in symplectic maps, 15:38001 (J;US)

PARTICULATES
EPA [Environmental Protection Agency] performance tests for particulate and SO_2 conducted at the DOE Coal-Fired Flow Facility, 15:37041 (R;US)

PARTON MODEL
Parton distributions extracted from data on deep-inelastic lepton scattering, prompt photon production and the Drell-Yan process, 15:37789 (R;GB)

PASSIVE SOLAR HEATING SYSTEMS
Analysis of wallboard containing a phase change material, 15:37116 (R;US)
Conventional wallboard with latent heat storage for passive solar applications, 15:37117 (R;US)
Passive solar systems performance under conditions in Bulgaria, 15:36828 (R;US)

PASSIVE SOLAR WATER HEATERS
Experimental study of a self-pumping boiling collector solar hot water system, 15:36858 (J;US)

PATHOGENS
Free-living amoebae: Health concerns in the indoor environment, 15:37655 (R;US)

PATIENTS
Clinical neutron dosimetry: Part 1, Determination of absorbed dose in a patient treated by external beams of fast neutrons, 15:37938 (R;US)

PBFA
See PARTICLE BEAM FUSION ACCELERATOR

PBX DEVICES
Initial performance and characteristics of the PBX-M pellet injector, 15:38209 (RA;US)
PBX-M ohmic heating power supply upgrade, 15:38191 (RA;US)

PCB
See CHLORINATED AROMATIC HYDROCARBONS

PEAKS
Effects of extracolumn convolution on preparative chromatographic peak shapes, 15:37330 (R;US)

PEAT
Microbial liquefaction of peat for the production of synthetic fuels: Final progress report, 15:36694 (R;US)

PEATLANDS
See WETLANDS

PELLET INJECTION
Initial performance and characteristics of the PBX-M pellet injector, 15:38209 (RA;US)

PELLETS (FUEL)
See FUEL PELLETS

PEOPLE
See HUMAN POPULATIONS

PEP STORAGE RINGS
Estimate of allowable beam current at 12 GeV, 15:37505 (R;US)
Seepage into PEP tunnel, 15:37506 (R;US)

PERSONNEL
Biological characterization of radiation exposure and dose estimates for inhaled uranium milling effluents: Final report, 15:36803 (R;US)
Doses to railroad workers exposed to shipments of high-level radioactive waste, 15:36804 (R;US)
Internal dosimetry and control, 15:37667 (R;US)

PERSONNEL DOSIMETRY
Doses to railroad workers exposed to shipments of high-level radioactive waste, 15:36804 (R;US)
[Radiation protection]: Foreign trip report, April 8–16, 1988, 15:37670 (R;US)

PERSONNEL FILM DOSIMETRY
See PERSONNEL DOSIMETRY

PETROCHEMICAL FEEDSTOCKS
See CHEMICAL FEEDSTOCKS

PETROCHEMICAL PLANTS
Risk-based inspection guidelines, 15:36943 (J;US)

PETROLEUM
See also PETROLEUM FRACTIONS
Analytical methods for metals in petroleum and related products, 15:36737 (R;DE;In German)
Environmental compliance assessment findings for Weldon Spring Site Remedial Action Program, 15:36805 (R;US)
International petroleum statistics report, February 1990, 15:36731 (R;US)
National Institute for Petroleum and Energy Research monthly progress report for May 1990, 15:36726 (R;US)
Oil production in the United States, 15:36733 (BA;US)
Petroleum supply monthly, March 1990, 15:36730 (R;US)
Prospects for thermophilic microorganisms in microbial enhanced oil recovery (MEOR), 15:36723 (R;US)

PETROLEUM COKE
See PETROLEUM PRODUCTS

PETROLEUM FRACTIONS
See also PETROLEUM RESIDUES
Group contribution method for correlating and forecasting thermodynamic properties of petroleum fluids, 15:36738 (R;FR;In French)

PETROLEUM INDUSTRY
Economic and Energy Indicators. Bi-weekly report, 15:37011 (R;US)
International Energy Statistical Review. Monthly report, 15:36732 (R;US)
Oil production in the United States, 15:36733 (BA;US)
Petroleum industry restructuring: The influence of tax and antitrust policies, 15:36734 (BA;US)

PETROLEUM PRODUCTS
See also DIESEL FUELS
FUEL OILS
KEROSENE
Analytical methods for metals in petroleum and related products, 15:36737 (R;DE;In German)
International petroleum statistics report, February 1990, 15:36731 (R;US)
Petroleum supply monthly, March 1990, 15:36730 (R;US)

PETROLEUM RESIDUES
Short path molecular distillation and extraction with gases in the supercritical state for improved characterization of petroleum residues, 15:36736 (R;DE;In German)

PETT
See POSITRON COMPUTED TOMOGRAPHY

PHARMACEUTICALS
See DRUGS

PHASE CHANGE MATERIALS
Analysis of wallboard containing a phase change material, 15:37116 (R;US)

PHASE STUDIES
The EISI [Elemental and Interplanar Spacing Index] index—A search/match tool for electron diffraction phase analysis, 15:38347 (R;US)
PHENOLS
Enhanced flue gas denitrification using ferrous EDTA and a polyphenolic compound having combined antioxidant and reducing properties, 15:36706 (R;US)
PHOSPHATE GLASS
Short-range structure of fluorine-modified phosphate glass, 15:37292 (R;US)
PHOSPHORUS
The phosphorus and the transition metals chemistry, 15:37345 (R;FR;In French)
PHOSPHORUS 32
Investigation of radiation effects in Hiroshima and Nagasaki using a general Monte Carlo-discrete ordinates coupling scheme, 15:37932 (R;US)
PHOTOCONDUCTORS
Absolute x-ray power measurements with subnanosecond time resolution using type IIa diamond photoconductors, 15:37308 (J;US)
PHOTODISINTEGRATION
See PHOTONUCLEAR REACTIONS
PHOTOELECTRON SPECTROSCOPY
X-ray spectromicroscopy with a zone plate generated microprobe, 15:37543 (J;US)
PHOTOGRAPHS
See IMAGES
PHOTOMAGNETIC EFFECT
See VISIBLE RADIATION
PHOTOMAGNETOELECTRIC EFFECT
See MAGNETIC FIELDS
PHOTON BEAMS
A national photon dosimetry intercomparison, 15:37529 (R;ZA)
Generating radially polarized beams interferometrically, 15:37419 (J;US)
PHOTON DETECTION (X-RAY)
See X-RAY DETECTION
PHOTON-ATOM COLLISIONS
Excitation of atoms passing through a TEM_{00} Gaussian laser beam at relativistic velocities, 15:37415 (J;US)
PHOTON-PHOTON INTERACTIONS
Study of the all neutral final state of $f_2(1270)$ produced in two-photon collisions as a background to radiative neutrino counting on the Z^0 resonance, 15:37801 (J;US)
PHOTONS
Prospect of multiphoton induced inner shell excitations for x-ray laser pumping, 15:38296 (BA;US)
The experimental search for point sources above 1 TeV, 15:37699 (J;US)
PHOTONUCLEAR REACTIONS
Exclusive photonuclear reactions and asymptotic scaling, 15:37916 (J;US)
Experimental nuclear physics: Differential cross-section for n-p radiative capture at Esub n=61 MeV, 15:37829 (RA;ZA)
Recent photoreaction experiments at 1.3 GeV Tokyo ES, 15:37843 (RA;JP)
PHOTOSYNTHESIS
[Biotechnology and photosynthesis]: Foreign trip report, June 28–July 14, 1988, 15:36833 (R;US)
PHOTOSYNTHETIC REACTION CENTERS
Spectral hole burning and flourescence studies of a synthetic chlorophyll dimer, a bacterial antenna system and a bacterial reaction center, 15:36832 (R;US)
PHOTOVOLTAIC CELLS
See also SOLAR CELLS
Photovoltaic concentrator module technology, 15:36835 (R;US)
PHOTOVOLTAIC CONVERSION
Thin film photovoltaic options: An overview, 15:36838 (BA;US)
PHOTOVOLTAIC POWER PLANTS
SouthWest Region Experiment Station (SWRES) 1989 report, 15:36843 (R;US)
The synthesis of solar radiation data for sizing stand-alone photovoltaic systems, 15:36844 (R;US)
PHTHALOCYANINES
Molecular engineering: Highly ordered langmuir-blodgett films based on a cobalt phthalocyanine and its axial complexation, 15:37217 (J;US)
PHYSICAL PROTECTION DEVICES
Use of fiber optic equipment for security, 15:37384 (BA;US)
PI-1016 RESONANCES
See MESONS
PIGE ANALYSIS
See PROTON REACTIONS
PILES
See FOUNDATIONS
PINCH DEVICES
See also FIELD-REVERSED THETA PINCH DEVICES
Commissioning tests and simulation result comparison in RFX AC/DC converters, 15:38231 (RA;US)
Confinement physics research facility/ZTH: A progress report, 15:38156 (RA;US)
Electromagnetic compatibility of the machine measuring equipment in RFX experiment, 15:38230 (RA;US)
Quality assurance and quality control for the confinement physics research facility (CPRF) and ZTH experiment, 15:38110 (RA;US)
Technological aspects in the production of a large aluminum shell, 15:38113 (RA;US)
The RFX energy transfer units, 15:38221 (RA;US)
The construction of the RFX vacuum vessel, 15:38139 (RA;US)
The design of the CPRF (Confinement Physics Research Facility) control system, 15:38244 (RA;US)
Thermal analysis of the CPFR/ZTH apparatus, 15:38137 (RA;US)
PINES
Root and foliar nutrient concentrations in loblolly pine: Effects of season, site, and fertilization, 15:37609 (J;US)
PINS (FUEL)
See FUEL PINS
PION MINUS REACTIONS
Analysis of pion scattering to stretched states in ^{60}Ni and other nuclei using Woods-Saxon wave functions, 15:37854 (J;US)
Negative pion-nucleus elastic scattering at 30 and 50 MeV, 15:37860 (J;US)
PION PLUS REACTIONS
Analysis of pion scattering to stretched states in ^{60}Ni and other nuclei using Woods-Saxon wave functions, 15:37854 (J;US)
Reaction ^{58}Ni(π^+,*pp*) at T_{π^+}=160 MeV, 15:37866 (J;US)
PION PLUS-PROTON INTERACTIONS
Polarized-target asymmetry in pion-proton bremsstrahlung at 298 MeV, 15:37784 (J;US)
PION REACTIONS
See also PION MINUS REACTIONS
PION PLUS REACTIONS
Theory of the isotensor term in the pion-nucleus optical potential, 15:37912 (J;US)
PIONIC ATOMS
Chemistry of pionic atoms, 15:37718 (RA;JP;In Japanese)
PIONS
See also PIONS NEUTRAL
The π, K, proton electromagnetic form factors and new related DM2 results, 15:37768 (R;FR)
PIONS NEUTRAL
Exclusive photonuclear reactions and asymptotic scaling, 15:37916 (J;US)
Off-shell form factors and low energy theorems for pion photoproduction, 15:37919 (J;US)
PIPELINES
A modified criterion for evaluating the remaining strength of corroded pipe: Final report, 15:36749 (R;US)
Criteria for hot tap welding further studies: Final report: Volume 2, 15:36752 (R;US)
Engineering critical assessment of girth welds in small diameter pipe: Final report, 15:36750 (R;CA)
Review of procedures for welding onto pressurized pipelines: Final report: Volume 1, 15:36751 (R;US)

PIPES
Consequences of pipe ruptures in metal fueled, liquid metal cooled reactors, 15:36957 (R;US)
Engineering critical assessment of girth welds in small diameter pipe: Final report, 15:36750 (R;CA)
Investigation of sulfide-stress cracking at pipe seam welds, 15:36748 (R;US)
Pulsed-gas-metal-arc welding (PGMAW) of API 5LX-80 pipe: Final report, 15:37194 (R;US)
The use of flattened specimens to measure the Charpy V-notch impact properties of thin-wall pipe, 15:36746 (R;US)

PISTONS
Ross-Stirling engines: Variations on a theme, 15:37400 (R;CA)

PLANT FOSSILS
See FOSSILS

PLANT GROWTH
Factors controlling decomposition in arctic tundra and related root mycorrhizal processes: [Progress report], 15:37635 (R;US)

PLANTS
See also TREES
Annual radiological environmental monitoring report, Watts Bar Nuclear Plant, 1989, 15:37581 (R;US)
Annual radiological environmental operating report, Browns Ferry Nuclear Plant, 1989, 15:37582 (R;US)
Annual radiological environmental operating report, Sequoyah Nuclear Plant, 1989, 15:37583 (R;US)
Changes in terrestrial ecosystems after long-term exposure to airborne pollutants - studies on the effects of ozone and NO_x immissions on spontaneous vegetation. Final report, 15:37681 (R;DE;In German)
Dose-response-relationships for phytotoxic air pollutants, where no air quality standards have been established. Criteria for decision-making in special cases (TA Luft, 2.2.1.3), 15:37680 (R;DE;In German)
Synthesis of the low molecular weight heat shock proteins in plants, 15:37672 (J;US)

PLASMA
See also COLD PLASMA
COLLISIONLESS PLASMA
HIGH-BETA PLASMA
INHOMOGENEOUS PLASMA
LASER-PRODUCED PLASMA
NON-EQUILIBRIUM PLASMA
OPTICALLY THICK PLASMA
RELATIVISTIC PLASMA
COMPASS electrical systems and commissioning, 15:38112 (RA;US)
Electron swarms in two phase plasmas, 15:38084 (BA;US)
Emission spectroscopy of ECRH non-axisymmetric helium mirror plasmas, 15:38080 (BA;US)
Fluctuations and transport due to ion-temperature-gradient–driven instabilities, 15:38089 (J;US)
Generalized Langevin equation for plasma turbulence, 15:38058 (BA;US)
Neoclassical transport of toroidal momentum in tokamaks, 15:38091 (J;US)
Nonlinear interaction of intense laser pulses in plasmas, 15:38092 (J;US)
Numerical investigation of the plasma-grid interaction of the LBL HIF source, 15:37503 (BA;US)
Phenomenology, diagnostics, and non-LTE effects in plasma-particle interactions, 15:37332 (R;US)
Plasma vertical stability and feedback control for CIT, 15:38146 (RA;US)
Radial ion diffusion induced by cyclotron resonance heating at the thermal barrier region in the Phaedrus-B Tandem Mirror, 15:38087 (BA;US)
Resolution requirements for modeling streamer formation in a spark gap, 15:38066 (BA;US)
The electron energy distribution function of noble gases with flow, 15:38061 (BA;US)
The physics of the ionized media, 15:38025 (R;FR;In French)
[Atomic and molecular data for metallic impurities in fusion plasmas]: Foreign trip report, May 15–21, 1990, 15:38031 (R;US)

PLASMA ARC SPRAYING
Phenomenology, diagnostics, and non-LTE effects in plasma-particle interactions, 15:37332 (R;US)

PLASMA BETATRONS
Ion betatron, 15:38288 (BA;US)

PLASMA CONFINEMENT
See also INERTIAL CONFINEMENT
MAGNETIC CONFINEMENT
Beam studies in the L.B.L. MBE-4 device, 15:38297 (BA;US)

PLASMA DENSITY
Neutral beam emission spectroscopy diagnostic for measurement of density fluctuations on the TFTR tokamak, 15:38033 (R;US)

PLASMA DIAGNOSTICS
Characterization of the time-evolution of a microsecond electron beam diode with anode effects, 15:38072 (BA;US)
Curve-fitting analysis of time-resolved Thomson spectrograms from a plasma focus, 15:38070 (BA;US)
Holographic interferometry of gas-puff Z-pinches, 15:38075 (BA;US)
Improvements in microchannel plate operating characteristics, 15:38074 (BA;US)
MTX [Microwave Tokamak Experiment] diagnostics and timing system for FEL [free electron laser] heating experiments: Revision 1, 15:38276 (R;US)
Microsources of intense fusion in focused discharges of plasma focus, 15:38299 (BA;US)
Radiofrequency ionization of helium with turbulent flow-measurements versus theory, 15:38289 (BA;US)
Soft x-ray spectra of low-Z gases produced by laser irradiation of a high-pressure supersonic gas jet, 15:38076 (BA;US)
Studies of injected particle trajectories in the beat wave accelerator, 15:38056 (BA;US)

Cameras
Vacuum ultraviolet radiation from neon implosions, 15:38301 (BA;US)

Data Acquisition Systems
MTX [Microwave Tokamak Experiment] data acquisition and analysis computer network: Revision 1, 15:38053 (R;US)

Decay Instability
Ion acoustic decay instabilities in laser pellet interactions, 15:38057 (BA;US)

Emission Spectroscopy
Emission spectroscopy of ECRH non-axisymmetric helium mirror plasmas, 15:38080 (BA;US)

Faraday Cups
Beam studies in the L.B.L. MBE-4 device, 15:38297 (BA;US)

Langmuir Probe
Current drive by spheromak injection into a tokamak, 15:38090 (J;US)
Radial ion diffusion induced by cyclotron resonance heating at the thermal barrier region in the Phaedrus-B Tandem Mirror, 15:38087 (BA;US)
Real plasma effects of microwave radiation propagating perpendicular to a magnetized plasma, 15:38077 (BA;US)

Optical Systems
Turbulence studies of high pressure dynamic nitrogen arcs, 15:38059 (BA;US)

Probes
Design studies of the 2 mev heavy ion beam probe for text upgrade, 15:38073 (BA;US)

Ruby Lasers
Development of a laser diagnostic system at PBFA II for light-ion-beam research, 15:38088 (BA;US)

Spectroscopy
Magnetic flux generation and sawteeth in the MST reversed-field pinch, 15:38285 (BA;US)

Technology Assessment
Time resolved plasma characterization in a long conduction time planar plasma opening switch, 15:38085 (BA;US)

Thomson Scattering
Thomson scattering measurements on the high beta pinch Extrap-T1, 15:38046 (R;SE)

Ultraviolet Radiation
Impurity behaviour in the EXTRAP-T1 pinch experiment studied by VUV spectroscopy, 15:38048 (R;SE)

PLASMA DIAMAGNETISM
Plasma motion into a transverse magnetic field and plasma, 15:38060 (BA;US)

PLASMA DIODES
See THERMIONIC DIODES

PLASMA DISRUPTION
The control of plasma parameters to avoid high current disruptions in JET, 15:38012 (RA;US)

PLASMA DRIFT
On the roles of the density and temperature gradients in the theory of nonlinear drift waves, 15:38028 (R;DE)

PLASMA EXPANSION
Pulsed-laser evaporation technique for deposition of thin films: Physics and theoretical model, 15:37971 (J;US)

PLASMA FOCUS DEVICES
Microsources of intense fusion in focused discharges of plasma focus, 15:38299 (BA;US)

PLASMA HEATING
Experimental design of spectroscopic measurements of microwave electric field in MTX tokamak plasma, 15:38079 (BA;US)

PLASMA INSTABILITY
Electron swarms in two phase plasmas, 15:38084 (BA;US)
Fluctuations and transport due to ion-temperature-gradient–driven instabilities, 15:38089 (J;US)
Generalized Cherry oscillators and negative energy waves, 15:38027 (R;DE)
MHD equilibrium and stability considerations for high-aspect-ratio ARIES-I tokamak reactors, 15:38014 (RA;US)
Passive vertical stability of ITER (International Thermonuclear Experimental Reactor), 15:38013 (RA;US)
Plasma motion into a transverse magnetic field and plasma, 15:38060 (BA;US)
Technological aspects in the production of a large aluminum shell, 15:38113 (RA;US)
Theoretical study of stability analysis for relativistic planar magnetron, 15:38300 (BA;US)
[Conference on vector and parallel computing]: Foreign trip report, May 31, 1988–June 14, 1988, 15:38322 (R;US)

PLASMA OSCILLATIONS
See PLASMA WAVES

PLASMA PRODUCTION
Charge transport dynamics in surface flashover arcs, 15:38086 (BA;US)
Radiofrequency ionization of helium with turbulent flow-measurements versus theory, 15:38289 (BA;US)
Real plasma effects of microwave radiation propagating perpendicular to a magnetized plasma, 15:38077 (BA;US)

PLASMA SCRAPE-OFF LAYER
Effect of the equilibrium magnetic field on plasma edge fluctuations, 15:38016 (R;US)
New non-axisymmetric eigenmodes associated with an edge plasma layer, 15:38038 (R;JP)

PLASMA SHEATH
Holographic interferometry of gas-puff Z-pinches, 15:38075 (BA;US)

PLASMA SIMULATION
Air breakdown in the relativistic limit, 15:38078 (BA;US)
Characterization of the time-evolution of a microsecond electron beam diode with anode effects, 15:38072 (BA;US)
Electron swarms in two phase plasmas, 15:38084 (BA;US)
Including electron-electron collisions in Monte Carlo simulations of swarms in partially ionized plasmas, 15:38298 (BA;US)
Modelling of the vapor shield mechanism during high heat flux ablation of surfaces, 15:38277 (BA;US)
Nuclear radiation analysis of the IGNITEX experiment, 15:38295 (BA;US)
Resolution requirements for modeling streamer formation in a spark gap, 15:38066 (BA;US)
Studies of injected particle trajectories in the beat wave accelerator, 15:38056 (BA;US)
Theoretical study of stability analysis for relativistic planar magnetron, 15:38300 (BA;US)
Vacuum ultraviolet radiation from neon implosions, 15:38301 (BA;US)

PLASMA SWITCHES
Performance of magnetically injected plasma opening switches for the Particle Beam Fusion Accelerator 2 (PBFA 2), 15:38263 (R;US)
Time resolved plasma characterization in a long conduction time planar plasma opening switch, 15:38085 (BA;US)

PLASMA WAVES
Large amplitude waves and fields in plasmas, 15:38039 (R;GB)

PLASMATRONS
Potential applications of an electron cyclotron resonance multicusp plasma source, 15:37716 (R;US)

PLASTICS
Recycling of plastics in automobile shredder residue, 15:37142 (R;US)

PLATES
Wide-plate crack-arrest tests utilizing prototypical and degraded (simulated) pressure vessel steels, 15:36995 (BA;US)

PLATINUM
A comparative kinetic study of xenon adsorption on a flat Pt(111) and stepped Pt(557) and Pt(112) surfaces, 15:37366 (J;US)

PLATINUM 177
Intrinsic states and rotational bands in ^{177}Pt, 15:37873 (R;AU)

PLUTONIUM 239
Off-Site Radiation Exposure Review Project: Phase 2 soils program: Revision, 15:37596 (R;US)
Onsite environmental report for the Nevada Test Site, January 1988–December 1988, 15:37567 (R;US)

PLUTONIUM 239 TARGET
Resonance analysis of the ^{239}Pu neutron cross sections in the energy range 300 to 2000 eV, 15:37885 (R;US)

PLUTONIUM 240
Off-Site Radiation Exposure Review Project: Phase 2 soils program: Revision, 15:37596 (R;US)

PLUTONIUM 241
Off-Site Radiation Exposure Review Project: Phase 2 soils program: Revision, 15:37596 (R;US)

PLUTONIUM COMPOUNDS
The photochemical behaviour of plutonium (IV), 15:37368 (R;CN;In Chinese)

PMMA
Observation of a phase transition in the sedimentation velocity of hard spheres, 15:37964 (J;US)

POISONS (CHEMICAL)
See HAZARDOUS MATERIALS

POLAR-CAP AURORAE
Two theories of auroral electron acceleration, 15:37705 (R;GB)

POLARIZATION-ASYMMETRY RATIO
Analyzing powers of (p vector,2p) reactions at Ep = 3.5 GeV and relativistic effects, 15:37868 (RA;JP;In Japanese)

POLARIZED BEAMS
Generating radially polarized beams interferometrically, 15:37419 (J;US)
Overcoming intrinsic and synchrotron depolarizing resonances with a Siberian snake, 15:37463 (J;US)
Test apparatus of GaAs spin polarized electron source at Nagoya University, 15:37487 (RA;JP)

POLARIZED TARGETS
Construction and test of the Bonn frozen spin target, 15:37465 (R;DE;In German)
Deuteron polarization of solid DT, 15:38308 (J;US)

POLLUTANTS
A comparison of direct control and market based policies for controlling emissions, 15:36709 (R;US)
Second-generation pressurized fluidized bed [PFB] combustion plant: Conceptual design and optimization of a second-generation PFB combustion plant, Phase 1, Task 1: Volume 1, 15:36888 (R;US)

POLLUTION CONTROL
A comparison of direct control and market based policies for controlling emissions, 15:36709 (R;US)

POLLUTION CONTROL EQUIPMENT
See also ELECTROSTATIC PRECIPITATORS
SCRUBBERS
Advances in air-stripper technology, 15:37612 (R;US)
Spray-dryer flue-gas-cleaning systems handbook, 15:36892 (R;US)
POLY(ISOBUTYLENE OXIDE)
See EPOXIDES
ORGANIC POLYMERS
POLY(VINYLIDENE FLUORIDE)
See FLUORINATED ALIPHATIC HYDROCARBONS
POLYACETYLENES
Production and depletion of long-lived charged non-bond-alternating defects in polyacetylene with mid-band-gap photolysis, 15:37323 (J;US)
POLYACRYLONITRILE
See ORGANIC POLYMERS
POLYCRYSTALS
Diffusion-accommodated grain boundary sliding in a polycrystal, 15:37179 (R;US)
POLYCYCLIC AROMATIC AMINES
A time-resolved Raman study of the reaction of OH radicals with p-phenylenediamine, 15:37370 (J;US)
POLYCYCLIC NITRO COMPOUNDS
Emission and biological activity of N-containing polycyclic aromatic compound as exhaust of Diesel engines, 15:37158 (R;DE;In German)
POLYETHYLENES
Vibrational pressure tuning spectroscopy of the polymethylene chain. 2. Various polyethylenes, 15:37361 (J;US)
POLYMERS
See also ORGANIC POLYMERS
A lattice model describing hydrogen bonding in polymer mixtures, 15:37320 (J;US)
Optical damage in epoxy polymers by millisecond light pulses, 15:37304 (BA;US)
Thermal expansion of beta-eucryptite filled bismaleimide and glass/bismaleimide composites, 15:37295 (R;US)
[Theoretical techniques for dynamics studies of polymers]: Foreign trip report, July 30–August 22, 1988, 15:37289 (R;US)
POLYMETHYLMETHACRYLATES
See PMMA
POLYNOMIALS
Multivariable biorthogonal continuous–discrete Wilson and Racah polynomials, 15:37997 (J;US)
POLYPROPYLENE
Polymeric electrolytes and polyelectrolytes: Salt concentration and domain, 15:37299 (BA;US)
POLYTETRAOXANE
See ORGANIC POLYMERS
POLYTHENE
See POLYETHYLENES
POROUS MATERIALS
Rate equation and scaling for fragmentation with mass loss, 15:37967 (J;US)
Relationship between permeability and diffusion-controlled trapping constant of porous media, 15:37745 (J;US)
Slow wave propagation in air-filled porous materials and natural rocks, 15:37963 (J;US)
PORPHYRINS
Geoporphyrin analysis using an ion trap mass spectrometer, 15:36721 (J;US)
PORTSMOUTH GASEOUS DIFFUSION PLANT
Fire protection review revisit No. 2, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio, 15:36799 (R;US)
POSITION SENSITIVE DETECTORS
Detectors for the asymmetric B factory, 15:37524 (RA;JP;In Japanese)
Silicon vertex detector, 15:37525 (RA;JP)
POSITRON BEAMS
Prospect of electron polarization at TRISTAN, 15:37508 (RA;JP)
POSITRON COMPUTED TOMOGRAPHY
PET imaging: An overview and instrumentation, 15:37654 (J;US)
Positron Emission Tomography (PET): Final report, January 15, 1989–January 14, 1990, 15:37643 (R;US)
POSITRON SOURCES
Positron sources, 15:37711 (R;FR)
Study of a positron source generated by photons from ultrarelativistic channeled particles, 15:37710 (R;FR)
POSITRON-ELECTRON-PROTON STORAGE RING
See PEP STORAGE RINGS
POTABLE WATER
See DRINKING WATER
POTASSIUM COMPOUNDS
See also POTASSIUM OXIDES
Structural changes in fast ion conducting chloride Doped potassium borate glasses, 15:37303 (BA;US)
POTASSIUM OXIDES
Anomalous pressure dependence of optical reflectivity in the superconductor $Ba_{0.6}K_{0.4}BiO_3$, 15:37278 (J;US)
POTENTIAL (ELECTRIC)
See ELECTRIC POTENTIAL
POTENTIAL BARRIERS
See POTENTIALS
POTENTIALS
See also LENNARD-JONES POTENTIAL
Multiple scattering theory for space filling potentials, 15:37987 (R;US)
POWDERS
Synthesis of high purity sinterable silicon carbide powder: Final report, 15:37237 (R;US)
The EISI [Elemental and Interplanar Spacing Index] index—A search/match tool for electron diffraction phase analysis, 15:38347 (R;US)
POWER DISTRIBUTION SYSTEMS
The RFX pulse transmission network, 15:38205 (RA;US)
POWER EXCURSIONS
See EXCURSIONS
POWER GENERATION
Assessing the potential environmental impacts of proposed rules affecting future electric power generation in the United States, 15:36901 (R;US)
POWER REACTORS
See also ARDENNES REACTOR
CHERNOBYLSK-4 REACTOR
DIABLO CANYON-1 REACTOR
DIABLO CANYON-2 REACTOR
EBR-2 REACTOR
SPACE POWER REACTORS
THREE MILE ISLAND-2 REACTOR
VOGTLE-1 REACTOR
A summary of microbial influenced corrosion in nuclear power plants, 15:36992 (BA;US)
Nuclear reactors built, being built, or planned: 1989, 15:36902 (R;US)
Nuclear reactors built, being built, or planned: 1989: Supplement, 15:36903 (R;US)
POWER SUPPLIES
Analysis of the poloidal field system leads in the IGNITEX experiment, 15:38116 (RA;US)
Commissioning tests and simulation result comparison in RFX AC/DC converters, 15:38231 (RA;US)
DIII-D F-coil chopper selection, control and fault recognition system, 15:38229 (RA;US)
Microwave Tokamak Experiment (MTX) ohmic heating system, 15:38220 (RA;US)
PBX-M ohmic heating power supply upgrade, 15:38191 (RA;US)
Plasma vertical stability and feedback control for CIT, 15:38146 (RA;US)
Preliminary power supply design for the TF coil system of CIT, 15:38189 (RA;US)
TFTR CAMAC power supplies reliability, 15:38109 (RA;US)
The design of RF power supply using DC-DC converter, 15:38192 (RA;US)
POWER SYSTEMS
See also RANKINE CYCLE POWER SYSTEMS
An FEL power source for a TeV linear collider, 15:37483 (RA;US)

An RF-driven lasertron, 15:37473 (RA;US)
The Alcator C-MOD power system, 15:38190 (RA;US)
The use of a single source to drive a binary peak power multiplier, 15:37479 (RA;US)

POWER TRANSMISSION LINES
138-kV six-phase Charleroi-Yukon Line uprating study for Allegheny Power Service Corporation, 15:36999 (R;US)

POWER TRANSMISSION TOWERS
Direct embedment foundation research: Load test summaries: Final report, 15:36998 (R;US)

PRASEODYMIUM
Determination of the valence of Pr, Gd, and Ho in $YBa_2Cu_3O_7$ by x-ray absorption spectroscopy, 15:37221 (J;US)

PRESSURE VESSELS
Analysis of the VENUS-3 experiments, 15:36912 (R;US)
Characteristics of the IAEA correlation monitor material for surveillance programmes, 15:37199 (R;FI)
PR-EDB: Power Reactor Embrittlement Data Base, version 1: Program description, 15:36907 (R;US)
Parameters and requirements for the B Factory vacuum chamber, 15:37507 (R;US)
Recertification of a high pressure vessel using nondestructive evaluation techniques, 15:36891 (BA;US)
Sizing the vacuum chambers conservatively, 15:37484 (R;US)

PRESSURIZED WATER COOLED MODERATED REACTOR
See PWR TYPE REACTORS

PRESSURIZED WATER REACTORS
See PWR TYPE REACTORS

PRESSURIZERS
Aging considerations for pressurizers in nuclear power plants, 15:36993 (BA;US)

PRIMATES
See also MAN
SPECT [single photon emission computed tomography] assay of radiolabeled monoclonal antibodies: Progress report, September 1989–April 1990, 15:37645 (R;US)

PROBES
Sol-gel coating on acoustic wave devices: Thin film characterization and chemical sensor development, 15:37238 (R;US)

PROCESSING (DATA)
See DATA PROCESSING

PRODUCTION (HYDROGEN)
See HYDROGEN PRODUCTION

PRODUCTION (PARTICLE)
See PARTICLE PRODUCTION

PRODUCTION (PLASMA)
See PLASMA PRODUCTION

PRODUCTION REACTORS
Extensions to SCDAP/RELAP5/MOD2 debris analysis models for the severe accident analysis of Savannah River Site (SRS) reactors preliminary design report, 15:36967 (R;US)
Nuclear reactors built, being built, or planned: 1989, 15:36902 (R;US)

PROGRAM MANAGEMENT
Operational readiness review plan for the radioisotope thermoelectric generator materials production tasks, 15:37043 (R;US)

PROGRAMMING
See also DATA-FLOW PROCESSING
PARALLEL PROCESSING
Object oriented programming, 15:38333 (R;US)

PROJECT MANAGEMENT
See PROGRAM MANAGEMENT

PROJECTILES
Hypervelocity explosive launchers, 15:37549 (R;US)

PROPAGATION (WAVE)
See WAVE PROPAGATION

PROPAGATOR
The linearized gauge field propagator in an inhomogeneous medium, 15:37808 (J;US)

PROPULSION REACTORS
Nuclear reactors built, being built, or planned: 1989, 15:36902 (R;US)

PROPULSION SYSTEMS
1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion: Proceedings, 15:37138 (R;US)
Three-dimensional parametric study for MHD marine propulsion, 15:37155 (R;US)

PROTAMINES
Accelerator mass spectrometry in the biomedical sciences: Applications in low-exposure biomedical and environmental dosimetry, 15:37653 (R;US)

PROTECTION
See SAFETY

PROTECTION (RADIATION)
See RADIATION PROTECTION

PROTECTIVE CLOTHING
Effects of a modified through-mask drinking system (MDS) on fluid intake during exercise in chemical protective gear. Report for January-May 1989, 15:37558 (R;US)

PROTEINS
Synthesis of the low molecular weight heat shock proteins in plants, 15:37672 (J;US)

PROTON REACTIONS

Capture
Experimental nuclear physics: High-energy proton radiative capture, 15:37833 (RA;ZA)

Carbon 14 Target
Two-nucleon correlations in ^{14}C through (p,t) reaction, 15:37852 (RA;JP;In Japanese)

Charge-Exchange Reactions
Zero-degree cross sections for the $^{7}Li(p,n)^{7}Be$(g.s.+0.43-MeV) reaction in the energy range 80–795 MeV, 15:37858 (J;US)

Delta Baryons
pd-^{3}He $\pi^0(t\pi^+)$ reaction and NNΔ resonance, 15:37846 (RA;JP;In Japanese)

Deuterium Target
Production of 7 meson by p+d→^{3}He+7 reaction at the near threshold, 15:37902 (RA;JP;In Japanese)
pd-^{3}He $\pi^0(t\pi^+)$ reaction and NNΔ resonance, 15:37846 (RA;JP;In Japanese)

Drift Chambers
Study of the NN interaction through (p, 2p) reactions and construction of focal plane detectors for a spectrograph pair, 15:37907 (RA;JP;In Japanese)

Elastic Scattering
Effective interactions and nuclear structure using 180 MeV protons. I. $^{16}O(p,p')$, 15:37857 (J;US)
Scattering of polarized protons from ^{6}Li at 200 MeV, 15:37855 (J;US)

Eta Mesons
Production of 7 meson by p+d→^{3}He+7 reaction at the near threshold, 15:37902 (RA;JP;In Japanese)

Excitation
Nuclear physics through charge-exchange reactions, 15:37847 (RA;JP;In Japanese)

High Spin States
(p,π^-) reactions leading to the high-spin stretched 2p-1h states within the two-nucleon production model, 15:37906 (RA;JP;In Japanese)

Inelastic Scattering
Effective interactions and nuclear structure using 180 MeV protons. I. $^{16}O(p,p')$, 15:37857 (J;US)
Scattering of polarized protons from ^{6}Li at 200 MeV, 15:37855 (J;US)

Knock-Out Reactions
Analyzing powers of (p vector,2p) reactions at Ep = 3.5 GeV and relativistic effects, 15:37868 (RA;JP;In Japanese)
Study of the NN interaction through (p, 2p) reactions and construction of focal plane detectors for a spectrograph pair, 15:37907 (RA;JP;In Japanese)

Neutrons
Nuclear physics through charge-exchange reactions, 15:37847 (RA;JP;In Japanese)

P Invariance
Parity-violating asymmetry in $\vec{p}\,p$ scattering at medium energies, 15:37911 (J;US)

Pickup Reactions
Two-nucleon correlations in ^{14}C through (p,t) reaction, 15:37852 (RA;JP;In Japanese)
Pions Minus
(p,π^-) reactions leading to the high-spin stretched 2p-1h states within the two-nucleon production model, 15:37906 (RA;JP;In Japanese)
Precompound-Nucleus Emission
Preequilibrium (*p,n*) reaction as a probe for the effective nucleon-nucleon interaction in multistep direct processes, 15:37863 (J;US)
PROTON RECOIL DETECTORS
Method of energy calibration of the TANSY neutron detectors, 15:37516 (R;SE)
PROTON-ANTIPROTON INTERACTIONS
A study on low-energy proton-antiproton pair annihilation by means of planar quark diagram picture, 15:37791 (RA;JP;In Japanese)
One-jet inclusive cross section at order α_s^3: Quarks and gluons, 15:37802 (J;US)
Recent results on direct photons from CDF [Collider Detector at Fermilab], 15:37760 (R;US)
The dijet invariant mass at the Tevatron Collider, 15:37755 (R;US)
PROTON-NEUTRON INTERACTIONS
Analyzing power measurement for forward angle *n-p* scattering at 790 MeV, 15:37786 (J;US)
PROTON-PROTON INTERACTIONS
A phase shift analysis of proton-proton scattering in P_L = 1.0 - 2.2 GeV/c region and diproton resonances, 15:37896 (RA;JP)
Analyzing power measurements in pp elastic scattering with an internal target, 15:37828 (RA;JP)
PP scattering with an internal target, 15:37778 (RA;JP)
Phase shift analysis of nucleon-nucleon scattering, 15:37897 (RA;JP)
PROTONS
Experimental nuclear physics: Continuum decay associated with the scattering of 200 MeV protons from sup 12C, 15:37831 (RA;ZA)
Methods of calculating the Barkas-effect correction to Bethe–Bloch stopping power, 15:37935 (J;US)
Microsources of intense fusion in focused discharges of plasma focus, 15:38299 (BA;US)
Overcoming intrinsic and synchrotron depolarizing resonances with a Siberian snake, 15:37463 (J;US)
The π, K, proton electromagnetic form factors and new related DM2 results, 15:37768 (R;FR)
PSI RESONANCES
See MESONS
PSI-3105 RESONANCES
See J PSI-3097 MESONS
PSI-4300 RESONANCES
See MESONS
PUBLIC HEALTH
Global climate change and human health: Information needs, research priorities, and strategic considerations, 15:37563 (R;US)
PUBLIC RELATIONS
It's not hype, it's communication: Using public relations techniques to improve your technical messages, 15:38344 (R;US)
PUERTO RICO
Trace elements concentrations at San Juan metropolitan area and at El Yunque peak, 15:37589 (BA;US)
PULPS
See SLURRIES
PULSE COMBUSTORS
Pulse combustion: The quantification of characteristic times, 15:37397 (J;US)
PULSE GENERATORS
See also HIGH-VOLTAGE PULSE GENERATORS
The repetitive high energy pulsed power module, 15:37411 (R;US)
PULSED FUSION REACTORS
Numerical and theoretical developments in plasma erosion opening switch research, 15:38287 (BA;US)
The mirrortron ion accelerator concept, 15:38064 (BA;US)
Time resolved plasma characterization in a long conduction time planar plasma opening switch, 15:38085 (BA;US)
PURINES
The role of purine degradation in methane biosynthesis and energy production in Methanococcus vannielii: Progress report, March 1, 1989–February 28, 1990, 15:37634 (R;US)
PWR TYPE REACTORS
See also ARDENNES REACTOR
DIABLO CANYON-1 REACTOR
DIABLO CANYON-2 REACTOR
LOFT REACTOR
THREE MILE ISLAND-2 REACTOR
VOGTLE-1 REACTOR
Aging considerations for pressurizers in nuclear power plants, 15:36993 (BA;US)
Analysis of the VENUS-3 experiments, 15:36912 (R;US)
Closeout of IE Bulletin 84-03: Refueling cavity water seal: Final report, 15:36979 (R;US)
Data summary report for fission product release test VI-3, 15:36944 (R;US)
Fatigue degradation of nozzles and piping in a PWR reactor coolant system, 15:36994 (BA;US)
Heat transfer in reactor cavity during core-concrete interaction, 15:36909 (R;FR)
MAAP [Modular Accident Analysis Program] steam generator modeling and benchmarking with Westinghouse MB-2 tests, 15:36968 (R;US)
Objectives, specification and elaboration of technical scenarios for emergency drills involving a French PWR, 15:36908 (R;FR)
PR-EDB: Power Reactor Embrittlement Data Base, version 1: Program description, 15:36907 (R;US)
Parameter and fluence-rate covariances in lepricon, 15:36911 (R;US)
Prevention of early containment failure due to high pressure melt ejection and direct containment heating for advanced light water reactors: Advanced Reactor Severe Accident Program, 15:36965 (R;US)
Technical support for the EPRI [Electric Power Research Institute] debris coolability requirement for advanced light water reactors: Advanced Reactor Severe Accident Program, 15:36904 (R;US)
Transactions of the 10th international conference on structural mechanics in reactor technology, 15:36991 (B;US)
[Advanced technologies for water-cooled reactors]: Foreign trip report, May 24–June 12, 1988, 15:36985 (R;US)
PYRENE
Supercritical fluid thermodynamics for coal processing: Quarterly progress report, January 1, 1990–March 31, 1990, 15:36695 (R;US)
PYRIDINE
Macromolecular coal structure as revealed by novel diffusion tests: Quarterly technical report, January 15, 1990–April 15, 1990, 15:36703 (R;US)
PYROCHLORE
Intrinsic fast oxygen ionic conductivity in the $Gd_2(Zr_xTi_{1-x})_2O_7$ and $Y_2(Zr_xTi_{1-x})_2O_7$ pyrochlore systems, 15:37246 (BA;US)
PYROLYSIS
Investigation of particulate formation during diesel spray combustion: Technical progress quarterly report, March 1–May 31, 1990, 15:37371 (R;US)
PYRRHITE
See PYROCHLORE

Q

QUANTUM CHROMODYNAMICS
Baryons and ladders, 15:37788 (R;DK)
Chiral logarithms in quenched m_π and f_π, 15:37821 (J;US)
Deformations of conformal field theories and symmetries of the string, 15:37819 (J;US)
One-jet inclusive cross section at order α_s^3: Quarks and gluons, 15:37802 (J;US)

QCD mixing effects in a gauge invariant quark model for photo- and electroproduction of baryon resonances, 15:37790 (R;GB)
The linearized gauge field propagator in an inhomogeneous medium, 15:37808 (J;US)
The structure of gluon radiation in QCD, 15:37813 (J;US)

QUANTUM ELECTRODYNAMICS
An inclusive and exclusive algorithm for QED evolution, 15:37798 (J;US)
Multimode squeeze operators and squeezed states, 15:38003 (J;US)
The renormalization group improved YFS [Yennie-Frautschi-Suura] method in QED, 15:37795 (J;US)

QUANTUM FIELD THEORY
See also LAGRANGIAN FIELD THEORY
QUANTUM CHROMODYNAMICS
QUANTUM ELECTRODYNAMICS
QUANTUM GRAVITY
Hot δ expansion, 15:37822 (J;US)
Relativistic energy-momentum relationship for a soliton, 15:37823 (J;US)

QUANTUM GRAVITY
Stability of random surfaces, 15:37818 (J;US)

QUANTUM MECHANICS
Propagators for shape-invariant potentials, 15:38000 (J;US)
Quantum logistic map, 15:38005 (J;US)
Quantum optics, 15:37187 (R;FR;In French)
Test of the linearity of quantum mechanics in an atomic system with a hydrogen maser, 15:37722 (J;US)

QUANTUM NUMBERS
Late-time dissipation of primordial baryon-number fluctuations and nucleosynthesis, 15:37804 (J;US)

QUARK-ANTIQUARK INTERACTIONS
Nuclear dependence of dimuon production at 800 GeV, 15:37782 (J;US)

QUARK-GLUON INTERACTIONS
Experimental results from studies on nucleus-nucleus collisions at high energy, 15:37826 (R;US)

QUERCUS
See OAKS

R

R-1650 RESONANCES
See MESONS

R-RNA
See RIBOSOMAL RNA

RADIATION ACCIDENTS
Preclinical diagnosis and emergency medical care in case of radiation accidents, 15:36972 (R;DE;In German)

RADIATION CURING
Proceedings of the international symposium on radiation vulcanization of natural rubber latex, 15:36817 (R;JP)

RADIATION DETECTORS
See also ELECTRON MULTIPLIER DETECTORS
NEUTRON DETECTORS
POSITION SENSITIVE DETECTORS
SHOWER COUNTERS
STREAK CAMERAS
MODIX active detector (drawings AAA88-1104683-OA) [Engineering materials], 15:37513 (E;US)
Radon-measurement comparison study, Butte, Montana-68 homes, 15:37573 (R;US)
VJACS detector assembly (HyJacs active detector), drawings AAA87-107748-OA [Engineering materials], 15:37514 (E;US)

RADIATION HYGIENE
See RADIATION PROTECTION

RADIATION PROTECTION
Radiation protection glossary, 15:37936 (R;SY;In Arabic)
The nuclear safety in France, in 1988, 15:36988 (R;FR;In French)
[Radiation protection]: Foreign trip report, April 8–16, 1988, 15:37670 (R;US)

RADIATION SAFETY
See RADIATION PROTECTION

RADIATION SOURCES
See also SEALED SOURCES
SYNCHROTRON RADIATION SOURCES
Interim report on low-cost cesium radiation sources from Hanford Waste Management Program, 15:36815 (R;US)
[Control of radiation sources]: Foreign trip report, September 24–October 2, 1988, 15:37016 (R;US)

RADIATIONS
See also BACKGROUND RADIATION
ELECTROMAGNETIC RADIATION
IONIZING RADIATIONS
SOLAR RADIATION
[Biological effects of atomic radiation]: Foreign trip report, May 11–19, 1989, 15:37671 (R;US)

RADIATIVE CORRECTIONS
Heavy flavor resonances and QED radiative corrections, 15:37799 (J;US)

RADIO GALAXIES
Radio loud far-infrared galaxies, 15:37695 (R;US)

RADIOACTIVE AEROSOLS
EIS (Environmental Impact Statement) NESHAPs (National Emission Standards for Hazardous Air Pollutants) for Radionuclides, 15:37574 (R;US)
Economic-assessment Environmental Impact Statement. NESPAHs (National Emission Standards for Hazardous Air Pollutants) for radionuclides. Background information document. Volume 3, 15:37577 (R;US)
Risk-assessments Appendixes Environmental Impact Statement. NESHAPs (National Emission Standards for Hazardous Air Pollutants) for Radionuclides. Background information document. Volume 2. Appendixes, 15:37576 (R;US)
Risk-assessments Environmental Impact Statement. NESHAPs (National Emission Standards for Hazardous Air Pollutants) for radionuclides. Background information document. Volume 2, 15:37575 (R;US)

RADIOACTIVE BIOLOGICAL WASTES
See RADIOACTIVE WASTES

RADIOACTIVE CLOUDS
Incorporation of an explosive cloud rise code into ARAC's [Atmospheric Release Advisory Capability] ADPIC transport and diffusion model, 15:37588 (R;US)

RADIOACTIVE GASEOUS WASTES
See GASEOUS WASTES
RADIOACTIVE WASTES

RADIOACTIVE MATERIALS
See also RADIOACTIVE WASTES
Annual radiological environmental monitoring report, Watts Bar Nuclear Plant, 1989, 15:37581 (R;US)
Annual radiological environmental operating report, Browns Ferry Nuclear Plant, 1989, 15:37582 (R;US)
Annual radiological environmental operating report, Sequoyah Nuclear Plant, 1989, 15:37583 (R;US)
Hanford Environmental Dose Reconstruction Project: Monthly report, 15:37579 (R;US)
Incorporation of an explosive cloud rise code into ARAC's [Atmospheric Release Advisory Capability] ADPIC transport and diffusion model, 15:37588 (R;US)
StateGEN/StateNET and DOT guidelines: Tools for highway routing of hazardous materials, 15:36763 (R;US)
Transportation accidents/incidents involving radioactive materials, (1971–1989), 15:36807 (R;US)
[Regulations for the safe transport of radioactive material]: Foreign trip report, September 27–30, 1988, 15:36761 (R;US)

RADIOACTIVE PARTICULATES
See PARTICLES
RADIOACTIVE AEROSOLS

RADIOACTIVE WASTE DISPOSAL
Characterization of fracture zone 2, Finnsjoen study-site, 15:36791 (R;SE)
Classification and disposal of radioactive wastes: History and legal and regulatory requirements, 15:36773 (R;US)
Classification of spent nuclear fuel (SNF), 15:36762 (R;US)

Performance assessment of alpha wastes disposal in deep geological formations, PACOMA project: granite option, 15:36768 (R;FR;In French)
Probabilistic system assessment code SYVAC/FI for safety analysis of nuclear waste disposal, 15:36792 (R;FI;In Finnish)
Safety assessment for radiactive waste disposal, 15:36767 (R;FR;In French)
Scenarios used for the evaluations of the safety of a site for adioactive waste disposal in deep geologic formations, 15:36770 (R;FR;In French)
Sensitivity analysis concerning dose equivalents associated with the disposal of radioactive wastes in deep geological formations, 15:36769 (R;FR;In French)

RADIOACTIVE WASTE FACILITIES
Conceptual model for radiological performance assessment of low-level-radioactive-waste disposal facilities, 15:36782 (R;US)
Hanford Waste Vitrification Plant foreign alternatives feasibility study: Revision 1, 15:36777 (R;US)
Performance assessment of alpha wastes disposal in deep geological formations, PACOMA project: granite option, 15:36768 (R;FR;In French)
Preliminary identification of scenarios that may affect the escape and transport of radionuclides from the Waste Isolation Pilot Plant, southeastern New Mexico, 15:36789 (R;US)
Westinghouse Hanford Company environmental surveillance annual report – 200/600 Areas: Calendar year 1989, 15:37624 (R;US)

RADIOACTIVE WASTE MANAGEMENT
Classification of spent nuclear fuel (SNF), 15:36762 (R;US)
Interim report on low-cost cesium radiation sources from Hanford Waste Management Program, 15:36815 (R;US)
The use of the Deep Kerfer for thick, steel-reinforced concrete cutting, 15:36775 (R;US)
Transporting spent and damaged fuel in the United States: Recent experience and lessons learned related to the evolving transportation policy of the US Department of Energy, 15:36760 (R;US)

RADIOACTIVE WASTES
See also ALPHA-BEARING WASTES
HIGH-LEVEL RADIOACTIVE WASTES
INTERMEDIATE-LEVEL RADIOACTIVE WASTES
LOW-LEVEL RADIOACTIVE WASTES
Classification and disposal of radioactive wastes: History and legal and regulatory requirements, 15:36773 (R;US)
Crucible melts and bench-scale ISV [in situ vitrification] tests on simulated wastes in INEL [Idaho National Engineering Laboratory] soils, 15:36786 (R;US)
Redesign of the PREPP [Process Experimental Pilot Plant] feed, ash discharge and sludge handling systems, 15:36778 (R;US)
Waste management '90: Working towards a cleaner environment: Waste processing, transportation, storage and disposal, technical programs and public education: Volume 1, Overview and general waste management: Proceedings, 15:36772 (R;US)

RADIOAPPLICATORS
See RADIATION SOURCES

RADIOBIOLOGY
The Pretoria cyclotron facility: Radiobiology, 15:37668 (RA;ZA)
[Radiation protection]: Foreign trip report, April 8–16, 1988, 15:37670 (R;US)

RADIOCARBON DATING
See CARBON 14

RADIOFREQUENCY SYSTEMS
See RF SYSTEMS

RADIOGRAPHS
See IMAGES

RADIOGRAPHY (INDUSTRIAL)
See INDUSTRIAL RADIOGRAPHY

RADIOISOTOPE MIGRATION
See RADIONUCLIDE MIGRATION

RADIOISOTOPE-LABELLED DRUGS
See RADIOPHARMACEUTICALS

RADIOISOTOPES
Environmental compliance assessment findings for Weldon Spring Site Remedial Action Program, 15:36805 (R;US)

RADIOLOGICAL PROTECTION
See RADIATION PROTECTION

RADIONUCLIDE MIGRATION
Reversibility of interaction of cesium with clay minerals, mud suspensions, and sediments of Dutch surface water bottom: Final report cesium project by request of DBW/RIZA, 15:37602 (R;NL;In Dutch)

RADIONUCLIDE TRANSFER (IN ENVIRONMENT)
See RADIONUCLIDE MIGRATION

RADIONUCLIDES
See RADIOISOTOPES

RADIOPHARMACEUTICALS
Positron Emission Tomography (PET): Final report, January 15, 1989–January 14, 1990, 15:37643 (R;US)
[Radiopharmaceutical chemistry]: Foreign trip report, June 28–July 9, 1988, 15:37652 (R;US)

RADIUM
Radium contamination in the environment. January 1972-July 1989 (A Bibliography from Pollution Abstracts). Report for January 1972-July 1989, 15:37620 (R;US)

RADON
Radon-measurement comparison study, Butte, Montana-68 homes, 15:37573 (R;US)

RADON 222
Activation of oncogenes by radon progeny and x-rays, 15:37665 (R;US)
Characterizing the occurrence, sources, and variability of radon in pacific northwest homes, 15:37591 (J;US)

RAILGUN ACCELERATORS
Results from recent hydrogen pellet acceleration studies with a 2-m railgun, 15:38212 (RA;US)

RAMAN SPECTRA
Development of a drug assay using surface-enhanced Raman spectroscopy, 15:37298 (R;US)
Effects of the transition dipole in Raman scattering, 15:37738 (J;US)

RANKINE CYCLE POWER SYSTEMS
Advanced binary geothermal power plants: Limits of performance, 15:36868 (R;US)

RARE EARTH ALLOYS
See also NEODYMIUM ALLOYS
Lorentz electron microscopy of iron-rare-earth-boron sintered permanent magnets, 15:37212 (J;US)

RARE EARTH COMPOUNDS
See also CERIUM COMPOUNDS
LANTHANUM COMPOUNDS
YTTERBIUM COMPOUNDS
Synthesis of organolanthanides by metal addition on insaturated substrates in ether and reactivity, 15:37348 (R;FR;In French)

RATS
Magnetic fields and behavior: Annual performance report, 1989–1990, 15:37685 (R;US)

REACTION INTERMEDIATES
A time-resolved Raman study of the reaction of OH radicals with p-phenylenediamine, 15:37370 (J;US)

REACTOR ACCIDENTS
See also EXCURSIONS
LOSS OF COOLANT
MELTDOWN
Fuel motions in the multi-pin PFR/TREAT test series, 15:36953 (R;US)
Heat transfer between stratified liquids with bubbling across the interface, 15:37392 (R;US)
Objectives, specification and elaboration of technical scenarios for emergency drills involving a French PWR, 15:36908 (R;FR)
Presentation of the ressac research program (rehabilitation of soils and surfaces after an accident), 15:36952 (R;FR)
Recent developments in the CONTAIN-LMR code, 15:36987 (R;US)

REACTOR COMPONENTS
See also BREEDING BLANKETS
FUEL ELEMENTS
REACTOR COOLING SYSTEMS
REACTOR CORES
Experimental and theoretical modeling of runaway electron damage for the design of tokamak plasma facing components, 15:38292 (BA;US)
Failure of Inconel X-750 bolts of internals of the CHOOZ-A nuclear power plant, 15:36910 (R;FR)
Nondestructive evaluation research progress in 1989: Proceedings from the tenth annual EPRI NDE information meeting, 15:36934 (R;US)
Transactions of the 10th international conference on structural mechanics in reactor technology, 15:36991 (B;US)
Transactions of the 10th international conference on structural mechanics in reactor technology, 15:36990 (B;US)
Transactions on the 10th international conference on structural mechanics in reactor technology, 15:36942 (B;US)

REACTOR CONTROL SYSTEMS
Human factors issues associated with advanced instrumentation and controls technologies in nuclear plants, 15:36939 (R;US)

REACTOR COOLING SYSTEMS
Consequences of pipe ruptures in metal fueled, liquid metal cooled reactors, 15:36957 (R;US)
Fatigue degradation of nozzles and piping in a PWR reactor coolant system, 15:36994 (BA;US)
The passive response of the Integral Fast Reactor concept to the chilled inlet accident, 15:36962 (R;US)

REACTOR CORES
Advances on the analysis of fast reactor core and coolant circuit structures, 15:36996 (BA;US)

REACTOR FUEL ELEMENTS
See FUEL ELEMENTS

REACTOR FUELS
See NUCLEAR FUELS

REACTOR INSTRUMENTATION
Human factors issues associated with advanced instrumentation and controls technologies in nuclear plants, 15:36939 (R;US)

REACTOR MATERIALS
See also NUCLEAR FUELS
Environmentally assisted cracking in light water reactors: Semiannual report, October 1988–March 1989: Volume 8, 15:36906 (R;US)
[Nuclear power engineering in space]: Foreign trip report, May 11, 1990–June 3, 1990, 15:36932 (R;US)

REACTOR MONITORING SYSTEMS
Transactions on the 10th international conference on structural mechanics in reactor technology, 15:36942 (B;US)
[Passive monitoring of nuclear systems]: Foreign trip report, May 18–30, 1988, 15:36940 (R;US)

REACTOR SAFETY
Transactions of the 10th international conference on structural mechanics in reactor technology, 15:36991 (B;US)

REACTOR SAFETY EXPERIMENTS
Transactions of the 10th international conference on structural mechanics in reactor technology, 15:36990 (B;US)

REACTOR VESSELS
Ultrasonic signal processing and B-SCAN imaging for nondestructive testing. Application to under - cladding - cracks, 15:36936 (R;FR;In French)
Wide-plate crack-arrest tests utilizing prototypical and degraded (simulated) pressure vessel steels, 15:36995 (BA;US)

RECEIVERS (SOLAR)
See SOLAR RECEIVERS

RECIPROCAL TRANSLOCATIONS
See CHROMOSOMAL ABERRATIONS

REFRIGERANTS
Selection of ozone-safe, nonazeotropic refrigerant mixtures for capacity modulation in residential heat pumps, 15:37130 (BA;US)

REGION IV
See FEDERAL REGION IV

REGION X
See FEDERAL REGION X

REGIONAL ANALYSIS
Adaptation and experimentation of management and physical economy models to the problems of the regional energy planning, 15:37007 (R;FR;In French)
Follow-up of the regional energy conservation politics. Methods and illustration with the case of Charente-Poitou, 15:37006 (R;FR;In French)

REGULATIONS
Environmental compliance assessment findings for Weldon Spring Site Remedial Action Program, 15:36805 (R;US)
Environmental regulatory update table, April 1990, 15:37014 (R;US)
Environmental regulatory update table, March 1990, 15:37013 (R;US)
Environmental regulatory update table, May 1990, 15:37015 (R;US)
Preliminary identification of scenarios that may affect the escape and transport of radionuclides from the Waste Isolation Pilot Plant, southeastern New Mexico, 15:36789 (R;US)
Tiger Team Assessment of the Lawrence Livermore National Laboratory, 15:36798 (R;US)
Tiger Team assessment of the Savannah River Site, 15:37012 (R;US)

REGULATORY GUIDES
KWOC [Key-Word-Out-of-Context] Index of US Nuclear Regulatory Commission Regulatory Guide Series, 15:37031 (R;US)

REINFORCED CONCRETE
The use of the Deep Kerfer for thick, steel-reinforced concrete cutting, 15:36775 (R;US)

REINFORCED MATERIALS
See also REINFORCED CONCRETE
Vitreous joining of SiC fiber reinforced SiC composites, 15:37284 (R;US)

RELATIVISTIC PLASMA
Phase-locking of multiple relativistic magnetrons, 15:38068 (BA;US)
Studies of injected particle trajectories in the beat wave accelerator, 15:38056 (BA;US)
Theoretical study of stability analysis for relativistic planar magnetron, 15:38300 (BA;US)

REMEDIAL ACTION
Environmental assessment for 881 Hillside (High Priority Sites) interim remedial action, 15:36797 (R;US)
Presentation of the ressac research program (rehabilitation of soils and surfaces after an accident), 15:36952 (R;FR)

REMOTE SENSING
Report of a workshop on using remote sensing to estimate land use change, 15:37600 (R;US)

RENEWABLE ENERGY SOURCES
See also BIOMASS
GEOTHERMAL ENERGY
SOLAR ENERGY
PIRSEM: 1987 operations review. Volume 1, 15:37045 (R;FR;In French)
PIRSEM: 1987 operations review. Volume 2, 15:37046 (R;FR;In French)

RENEWABLE RESOURCES
Energy storage and distribution program summary: Volume 2, Research summaries, Fiscal year 1989, 15:37021 (R;US)

REPRESENTATIONS (IRREDUCIBLE)
See IRREDUCIBLE REPRESENTATIONS

REPTILES
Distribution, habitat and habits of the desert tortoise (Gopherus agassizii) in the eastern Mojave Desert, 15:37595 (R;US)

RESEARCH AND TEST REACTORS
See also RESEARCH REACTORS
Nuclear reactors built, being built, or planned: 1989, 15:36902 (R;US)
Proposed neutron activation analysis facilities in the Advanced Neutron Source, 15:36945 (R;US)

RESEARCH PROGRAMS
A guide to increased creativity in research inspiration or perspiration, 15:37023 (J;US)
ARC: Chemical heat pumps, 15:37125 (R;FR;In French)
IGORR-1: Proceedings of the first meeting of the international group on research reactors, 15:36947 (R;US)
International aspects of Oak Ridge National Laboratory, 15:37024 (R;US)
PIRSEM: 1987 operations review. Volume 3, 15:37020 (R;FR;In French)
Research in the physical sciences: Low-energy nuclear physics, 15:37494 (RA;ZA)
Research in the physical sciences: Medium-energy nuclear physics, 15:37495 (RA;ZA)
The direction of the laboratories, 15:38342 (R;FR;In French)

RESEARCH REACTORS
See also ACPR REACTOR
FFTF REACTOR
GRENOBLE REACTOR
KUR REACTOR
ORPHEE REACTOR
IGORR-1: Proceedings of the first meeting of the international group on research reactors, 15:36947 (R;US)
Reactivity studies on the final preconceptual reference design of the Advanced Neutron Source, 15:36950 (R;US)

RESERVOIR ROCK
Cyclic CO_2 injection for light oil recovery: Performance of a cost shared field test in Louisiana: [Sixth quarterly report], April–June 1990, 15:36724 (R;US)
National Institute for Petroleum and Energy Research monthly progress report for May 1990, 15:36726 (R;US)

RESERVOIRS (WATER)
See WATER RESERVOIRS

RESID
See PETROLEUM RESIDUES

RESIDENCES
See HOUSES

RESIDENTIAL SECTOR
Analysis of air-to-air heat exchanger performance data taken under the Residential Standards Demonstration Program, 15:37128 (R;US)
Multicomponent case weights for the 1985 resample of the 1983 Pacific Northwest residential energy survey, 15:37126 (R;US)
The Residential Building Characteristics On-Site Inspection: Summary report, 15:37127 (R;US)

RESIDUAL OILS
See PETROLEUM RESIDUES

RESIDUES (RADIOACTIVE)
See RADIOACTIVE WASTES

RESISTIVITY (ELECTRIC)
See ELECTRIC CONDUCTIVITY

RESONANCE CAVITIES
See CAVITY RESONATORS

RESONANCE STATES
See ENERGY LEVELS

RESOURCE MANAGEMENT
Evaluation
An economic evaluation of efficiency improvements in residential water heating equipment, 15:37083 (RA;US)
An evaluation of carpooling projects at two Missouri rideshare programs, 15:37077 (RA;US)
An evaluation of central Maine Power Company's pilot water heater cycling program, 15:37072 (RA;US)
An evaluation of the Bonneville Power Administration wood heat displacement program, 15:37048 (RA;US)
An investigation of commercial and industrial utility demand-side management program impacts, 15:37100 (RA;US)
Analysis of weatherization measures in low-income mobile homes, 15:37060 (RA;US)
Are high-participation residential conservation programs still feasible? The Santa Monica RCS model revisited, 15:37098 (RA;US)
Assessment of state needs for information and technical assistance in planning and evaluating residential energy conservation programs, 15:37099 (RA;US)
Attrition bias in fuel savings evaluations of low-income energy conservation programs, 15:37078 (RA;US)
Case study analysis of the institutional buildings program in Washington State, 15:37090 (RA;US)
Comparative analysis of the effect of incentives on weatherization programs, 15:37049 (RA;US)
Comparative analysis of three commercial sector financing mechanisms, 15:37055 (RA;US)
Comparison of alternative segmentation approaches for residential customers, 15:37110 (RA;US)
Comprehensive evaluation: A commercial sector example, 15:37086 (RA;US)
Correction for self-selection bias: Theory and application, 15:37082 (RA;US)
Cost-effectiveness enlightenment: Which is the right test?, 15:37094 (RA;US)
Danish programs for efficient use of energy, 15:37068 (RA;US)
Demand-side management and economic development: A practical discussion, 15:37052 (RA;US)
Design assistance for new commercial buildings, 15:37101 (RA;US)
Durability of fuel savings for single-family households: Ohio Home Weatherization Assistance Program (HWAP) program years 1985 and 1986, 15:37058 (RA;US)
Electricity savings from a small C and I lighting retrofit program: Approaches and results, 15:37063 (RA;US)
Energy program evaluation using P/G% decision-aiding software, 15:37104 (RA;US)
Energy use and consumer dissimilarity in multifamily residential conservation, 15:37079 (RA;US)
Estimation of the incremental cost of constructing super good cents homes: Methodology and results, 15:37112 (RA;US)
Evaluating community energy management strategies using the options model, 15:37103 (RA;US)
Evaluating customer willingness to pay to avoid electric outages, 15:37066 (RA;US)
Evaluating energy and non-energy impacts of energy conservation programs: A supply curve framework of analysis, 15:37102 (RA;US)
Evaluating energy-efficiency programs: A personal view of progress and potential, 15:37115 (RA;US)
Evaluating the cost-effectiveness of a commercial and industrial conservation program, 15:37095 (RA;US)
Evaluating utility direct load control programs: The duty cycle approach, 15:37071 (RA;US)
Evaluation of Bonneville's commercial audit program, 15:37087 (RA;US)
Evaluation of California's Energy efficient building standards: The residential building monitoring project, 15:37111 (RA;US)
Evaluation of DOE's [Department of Energy] resource-leveraging partnerships for low-income weatherization, 15:37056 (RA;US)
Evaluation of a residential appliance rebate program using billing record analyses, 15:37085 (RA;US)
Evaluation of the Utah Institutional Conservation Program: Preliminary results, 15:37089 (RA;US)
Factors affecting response rates in commercial and industrial customer surveys, 15:37106 (RA;US)
First year evaluation of the NEES cooperative interruptible service program, 15:37065 (RA;US)
High efficiency fluorescent lighting program: An experiment with marketing techniques to reach commercial and small industrial customers, 15:37061 (RA;US)
Impact evaluation of project HELP: Direct weatherization for low-income, elderly, and handicapped customers, 15:37057 (RA;US)
Integrating process and impact evaluation findings to modify the oil help rebate measure list, 15:37107 (RA;US)
Integration of process evaluation and program design, 15:37064 (RA;US)
Limited-income elderly. Implications for program design and implementation, 15:37109 (RA;US)

Making conservation profitable: Issues for regulation and evaluation, 15:37114 (RA;US)
Marketing energy of conservation in an environment of abundance, 15:37051 (RA;US)
Measuring the value of customer service at Seattle City Light, 15:37074 (RA;US)
New Jersey conservation analysis project: Energy savings from residential programs, 15:37069 (RA;US)
PG and E's value of residential services research, 15:37075 (RA;US)
Persistence of energy savings in Seattle City Light's residential weatherization program, 15:37091 (RA;US)
Program evaluation of the New York State Energy Efficient Appliance Rebate Demonstration Program: The free rider factor, 15:37081 (RA;US)
Promoting the commercialization of energy innovations: An evaluation of the energy-related inventions program, 15:37053 (RA;US)
Residential direct load control: Comfort effects and predictors of load savings, 15:37070 (RA;US)
Residential energy efficiency and fuel choice, 15:37113 (RA;US)
Service quality study: Wisconsin Power and Light Company, 15:37073 (RA;US)
Serving vital needs: An evaluation of the energy savings for nonprofits program, 15:37088 (RA;US)
Shooting with a moving camera: Trends in commercial buildings energy consumption, 1979 through 1986, 15:37097 (RA;US)
Short-term energy evaluation program (STEEP) of the Illinois Weatherization program, 15:37059 (RA;US)
Some estimates of free rider proportions in demand-side management programs, 15:37080 (RA;US)
Testing the effectiveness of a residential rebate program by tracking sales of appliances inside and outside the utility's territory: The case of Wisconsin Electric's 1988 Smart Money Program, 15:37084 (RA;US)
The Michigan low-income weatherization energy education and incentives program, 15:37050 (RA;US)
The industrial lighting incentive program: Process and impact evaluation, 15:37062 (RA;US)
The persistence of energy savings over time: Two and three years after participation in a retrofit program, 15:37092 (RA;US)
The promotion of residential energy-efficient lighting: Results of Massachusetts Electric Company's Enterprise Zone Plan, 15:37105 (RA;US)
Third party contracting versus customer programs for commercial/industrial customers, 15:37054 (RA;US)
Toward a common method of reporting and comparing results from evaluations of residential conservation programs, 15:37093 (RA;US)
Using commercials to sell DSM programs: A measurement of customer response, 15:37076 (RA;US)
Utilization of residential energy conservation program evaluation in least-cost utility planning, 15:37067 (RA;US)
Variability in commercial markets and implications for program transferability, 15:37096 (RA;US)
Views and opinions on energy programs and services: Results of focus group interviews with low-income hispanics, blacks, and senior citizens, 15:37108 (RA;US)

RESOURCE RECOVERY ACTS
On the implementation of complex many-to-many relations in focus, 15:38321 (R;US)

REVERSE-FIELD PINCH
An energy confinement study of the MST [Madison Symmetric Torus] reversed field pinch using a Thomson scattering diagnostic, 15:38022 (R;US)
Research operations on reversed field pinch: Final report, February 12, 1986–January 31, 1988, 15:38259 (R;US)

RF SYSTEMS
A review of Gyroklystrons and a cost estimate for a Gyroklystron-driven supercollider, 15:37474 (RA;US)
Design and fabrication studies of high gradient accelerating structures for the CERN linear collider (CLIC), 15:37477 (RA;US)
The 8 MW, 8 GHz FTU LHRH system: R and D and design status, 15:38160 (RA;US)
The design of RF power supply using DC-DC converter, 15:38192 (RA;US)

RFLPS
Highly polymorphic locus D15S24 (CMW-1) maps to 15pter-q13. [HGM9 provisional no. D15S24], 15:37641 (J;US)

RHO-1500 RESONANCES
See MESONS

RHO-1700 RESONANCES
See MESONS

RHO-765 RESONANCES
See RHO-770 MESONS

RHO-770 MESONS
Tensor coupling of the ρ meson in a chiral confining model, 15:37803 (J;US)

RHODAMINES
Observation of molecular vibrations in the time domain with incoherent laser pulses, 15:37541 (J;US)

RHODIUM BORIDES
Density-of-states-driven transition from superconductivity to ferromagnetism in $Ce(Ru_{1-x}Rh_x)_3B_2$: Scenario for an exchange-split Kondo resonance, 15:37271 (J;US)

RIBOSOMAL RNA
Variable rRNA gene copies in extreme halobacteria, 15:37638 (J;US)

RICHLAND FFTF REACTOR
See FFTF REACTOR

RINGS (STORAGE)
See STORAGE RINGS

RISK ANALYSIS
See RISK ASSESSMENT

RISK ASSESSMENT
Integrated Reliability and Risk Analysis System (IRRAS) Version 2.0 user's guide, 15:36980 (R;US)
Sources and consequences of hypothetical bias in economic analyses of risk behavior: Draft, 15:37009 (R;US)

RISOE NATIONAL LABORATORY
Physics Department. Annual progress report 1 January - 31 December 1989, 15:37952 (R;DK)

RIVETS
See FASTENERS

ROADS
Feasibility of exclusive facilities for cars and trucks: Final report, 15:37140 (R;US)

ROBOTS
A virtual sensor approach to robot kinematic identification: Theory and experimental implementation, 15:37378 (R;US)
DOE/NE University Program in robotics for advanced reactors: Program plan, FY 1990–FY 1994, 15:37375 (R;US)
Integration of model-based and sensor-based control for a two-link flexible robot arm, 15:37382 (R;US)
Monocular 3D vision for a robot assembly environment, 15:37381 (R;US)
Proceedings of the 1989 CESAR/CEA [Center for Engineering Systems Advanced Research/Commissariat a l'Energie Atomique] workshop on autonomous mobile robots (May 30–June 1, 1989), 15:38331 (R;US)
[Automation and new technology]: Foreign trip report, August 31, 1988–September 12, 1988, 15:38326 (R;US)
[Computer vision and robotics]: Foreign trip report, January 22, 1989–January 28, 1989, 15:38328 (R;US)

ROCKS
Nonlinear elastic wave interactions in rock, 15:37287 (R;US)
Slow wave propagation in air-filled porous materials and natural rocks, 15:37963 (J;US)

ROCKY FLATS PLANT
Environmental assessment for 881 Hillside (High Priority Sites) interim remedial action, 15:36797 (R;US)

RODS (FUEL)
See FUEL RODS

ROOT ABSORPTION
Factors controlling decomposition in arctic tundra and related root mycorrhizal processes: [Progress report], 15:37635 (R;US)

ROUTING
StateGEN/StateNET and DOT guidelines: Tools for highway routing of hazardous materials, 15:36763 (R;US)
RUBBER (NATURAL)
See NATURAL RUBBER
RUNAWAY (REACTOR ACCIDENT)
See EXCURSIONS
RUNAWAY ELECTRONS
Modeling of runaway electron damage for the design of tokamak plasma facing components, 15:38148 (RA;US)
RUTHENIUM
Fundamental studies of supported ruthenium catalysts: Model reaction studies and NMR [nuclear magnetic resonance] of adsorbed molecules, 15:36699 (R;US)
RUTHENIUM BORIDES
Density-of-states-driven transition from superconductivity to ferromagnetism in $Ce(Ru_{1-x}Rh_x)_3B_2$: Scenario for an exchange-split Kondo resonance, 15:37271 (J;US)
RUTHENIUM COMPLEXES
High-energy metal to ligand charge-transfer states in ruthenium-diimine complexes, 15:37214 (J;US)
Photo-oxidation and photo-reduction of the ruthenium complex tris (2,2'bipyridine) in an organic medium. Applications to photoelectrochemical cells and photoinduced redox catalysis, 15:36830 (R;FR;In French)
The reactivity of the thioalkyne, MeSC≡CSMe, with ruthenium and tungsten complexes, 15:37351 (R;US)
RUTHENIUM COMPOUNDS
See also RUTHENIUM BORIDES
RUTHENIUM FLUORIDES
Shape of the upper-critical-field curves in URu_2Si_2: Evidence for anisotropic pairing, 15:37986 (J;US)
RUTHENIUM FLUORIDES
Synthesis and characterization of ruthenium fluorides and oxide fluorides with high oxidation states, 15:37347 (R;FR;In French)
RYDBERG STATES
The populations of Rydberg states of ions emerging from solid surfaces, 15:37708 (R;AU)

S

S-1000 RESONANCES
See MESONS
SACCHAROMYCES
Mechanisms and control of K^+ transport in plants and fungi, 15:37629 (R;US)
SAFEGUARDS
Game theoretical analysis of safeguards effectiveness. Pt. 3. Equilibrium solutions, 15:36810 (R;DE)
SAFETY
See also REACTOR SAFETY
Probabilistic system assessment code SYVAC/FI for safety analysis of nuclear waste disposal, 15:36792 (R;FI;In Finnish)
SAFETY (NUCLEAR)
See RADIATION PROTECTION
SAFETY (REACTOR)
See REACTOR SAFETY
SAFETY ENGINEERING
Fire protection review revisit No. 2, Portsmouth Gaseous Diffusion Plant, Piketon, Ohio, 15:36799 (R;US)
SALINE ZONE
See OIL SHALES
SALT CAVERNS
A model for transient natural convection in a vertical cylinder with sidewall heating, 15:36720 (R;US)
SALTON SEA GEOTHERMAL FIELD
[Sulfide-oxide-silicate phase equilibria and associated fluid inclusion properties in the Salton Sea geothermal system, California]: Final technical report, September 1, 1985–February 1, 1988, 15:36873 (R;US)
SAMPLING
Sampling plans to find faulty waste storage drums, 15:37377 (R;US)
SARCOMAS
Management and prognosis of patients with high-grade soft tissue sarcomas: An evaluation of a Scandinavian joint care program, 15:37648 (R;SE)
SAVANNAH RIVER PLANT
Extensions to SCDAP/RELAP5/MOD2 debris analysis models for the severe accident analysis of Savannah River Site (SRS) reactors preliminary design report, 15:36967 (R;US)
Tiger Team assessment of the Savannah River Site, 15:37012 (R;US)
SCALAR FIELDS
Scalar-tensor gravitational effects on vacuum decay, 15:37817 (J;US)
SCANNING ELECTRON MICROSCOPY
X-ray spectromicroscopy with a zone plate generated microprobe, 15:37543 (J;US)
SCATTERING
Proposed neutron activation analysis facilities in the Advanced Neutron Source, 15:36945 (R;US)
Scattering theory for self-adjoint extensions, 15:37993 (R;SE)
SCHOOL FACILITIES
See EDUCATIONAL FACILITIES
SCHOOL PLANT
See EDUCATIONAL FACILITIES
SCHOOLS
See EDUCATIONAL FACILITIES
SCHOTTKY BARRIER DIODES
Schottky barrier contacts on defect-free GaAs (110), 15:37421 (J;US)
SCIENTIFIC PERSONNEL
Distance learning conference proceedings, 15:38343 (R;US)
Training scientists and engineers for the year 2000: Testimony before the Subcommittee on Science, Technology, and Space , Committee on Commerce, Science, and Transportation, United States Senate, 15:37154 (R;US)
SCRAP METALS
Recycling of plastics in automobile shredder residue, 15:37142 (R;US)
SCREWS
See FASTENERS
SCRUBBERS
Use of ferrous chelates for NO_x control in aqueous scrubbers, 15:36707 (R;US)
SEALED SOURCES
Handling, conditioning and disposal of spent sealed sources: Technical manual for the management of low and intermediate level wastes generated at small nuclear research centres and by radioisotope users in medicine, research and industry, 15:37937 (R;XA)
SEALS
Closeout of IE Bulletin 84-03: Refueling cavity water seal: Final report, 15:36979 (R;US)
SEASONAL THERMAL ENERGY STORAGE
Heat pump and heliogeothermal space heating Aulnay-sous-Bois. The 1985 season, 15:36872 (R;FR;In French)
Optimizing the value-to cost ratio for central receiver electric power plants, 15:36848 (J;US)
SECONDARY BATTERIES
See ELECTRIC BATTERIES
SECONDARY RECOVERY
See ENHANCED RECOVERY
SEDIMENTATION
Observation of a phase transition in the sedimentation velocity of hard spheres, 15:37964 (J;US)
Sulfur cycling and fluxes in temperate dimictic lakes, 15:37613 (R;US)
SEDIMENTS
Annual radiological environmental monitoring report, Watts Bar Nuclear Plant, 1989, 15:37581 (R;US)
Annual radiological environmental operating report, Browns Ferry Nuclear Plant, 1989, 15:37582 (R;US)
Annual radiological environmental operating report, Sequoyah Nuclear Plant, 1989, 15:37583 (R;US)

SEISMIC WAVES
Application of the absorption of seismic waves in hydrocarbon exploration, 15:36719 (R;DE)
SELENIUM IONS
Effects of autoionizing resonances on electron-impact excitation rates for transitions among n=3 levels in neonlike selenium, 15:37725 (J;US)
SEM (MICROSCOPY)
See SCANNING ELECTRON MICROSCOPY
SEMICIRCULAR SPECTROMETERS
See FLAT MAGNETIC SPECTROMETERS
SEMICONDUCTOR DIODES
See also SCHOTTKY BARRIER DIODES
Fabrication of minority-carrier-limited n-Si/insulator/metal diodes, 15:36842 (J;US)
SEMICONDUCTOR LASERS
Low threshold current implanted-planar buried-heterostructure graded-index separate confinement heterostructure laser in GaAs/AlGaAs, 15:37418 (J;US)
SEMICONDUCTOR MATERIALS
High-resolution Z-contrast imaging in the stem, 15:37941 (R;US)
Incoherent imaging of materials structure and composition by Z-contrast stem, 15:37281 (R;US)
Interfaces and thin films physics, 15:37285 (R;FR;In French)
Vectorial electron transfer on designed surfaces. Final report, February 1984-December 1989, 15:37291 (R;US)
SEMICONDUCTOR RESISTORS
Polarization currents in varistors, 15:37252 (J;US)
Pulse response characteristics of ZnO varistors, 15:37262 (J;US)
SEMICONDUCTOR SWITCHES
Recovery of high field GaAs photoconductive semiconductor switches, 15:37410 (R;US)
SENA REACTOR
See ARDENNES REACTOR
SENSITIVITY ANALYSIS
Automated sensitivity analysis with the Gradient Enhanced Software System (GRESS), 15:38329 (R;US)
SEPARATION EQUIPMENT
Comparison of ethanol recovery processes from an immobilized cell reactor-separator, 15:37144 (R;US)
SEPARATION PROCESSES
Comparison of ethanol recovery processes from an immobilized cell reactor-separator, 15:37144 (R;US)
Membrane separation systems—A research and development needs assessment: Executive summary: Volume 1, 15:37147 (R;US)
Membrane separation systems—A research and development needs assessment: Final report: Volume 2, 15:37148 (R;US)
Scale-up and performance of an immobilized cell reactor separator for the production of ethanol from whey lactose, 15:36821 (R;US)
SEQUESTRENE
See EDTA
SHAFT EXCAVATIONS
Basalt Waste Isolation Project exploratory shaft site: Final reclamation report, 15:37601 (R;US)
SHALES
Derivative spectrophotometry of metalloporphyrins from shale, 15:36722 (J;US)
SHALLOW LAND BURIAL
See GROUND DISPOSAL
SHAPED CHARGES
Material characteristics related to the fracture and particulation of electrodeposited-copper shaped charge jets, 15:37198 (R;US)
SHEATHS (FUEL)
See FUEL CANS
SHELLS
Technological aspects in the production of a large aluminum shell, 15:38113 (RA;US)
SHIELDING
Modelling of the vapor shield mechanism during high heat flux ablation of surfaces, 15:38277 (BA;US)
Radiation shielding analysis for DIII-D, 15:38118 (RA;US)
SHIELDS
See also BIOLOGICAL SHIELDS
THERMAL SHIELDS
An assessment of the lifetime of Faraday shield elements, 15:38129 (RA;US)
Design considerations for penetrations in the TFTR radiation shield, 15:38214 (RA;US)
Shielding design options for the TF magnets of ITER (International Thermonuclear Experimental Reactor), 15:38226 (RA;US)
Shielding options for the ITER conceptual design, 15:38213 (RA;US)
Thermal and stress analysis of the Faraday shield for the ORNL/TFTR RF antenna, 15:38237 (RA;US)
SHIPMENT
See TRANSPORT
SHIPS
See also SUBMARINES
Three-dimensional parametric study for MHD marine propulsion, 15:37155 (R;US)
SHOWER COUNTERS
Radiation levels in SSC [Superconducting Super Collider] calorimetry, 15:37535 (R;US)
Recent developments in high-speed, non-sampling electromagnetic calorimetry, 15:37519 (R;US)
SDC at high luminosity, 15:37520 (R;US)
SI SEMICONDUCTOR DETECTORS
Progress report on the use of hybrid silicon pin diode arrays in high energy physics, 15:37533 (R;US)
The silicon strip detector at the Mark 2, 15:37534 (R;US)
SIALON
See ALUMINIUM OXIDES
SID
See SUDDEN IONOSPHERIC DISTURBANCE
SIEGBAHN SPECTROMETERS
See FLAT MAGNETIC SPECTROMETERS
SIGNALS
Curve fitting and error modeling for the digitization process near the Nyquist rate, 15:37402 (R;US)
Evaluation of a potential borehole televiewer technique for characterizing lost circulation zones, 15:36871 (R;US)
SILANES
Laser techniques for studying chemical vapor deposition, 15:37239 (R;US)
X-ray lithography studies of polysilane using a laser plasma x-ray source, 15:37960 (BA;US)
SILICA
Fast aggregation of colloidal silica, 15:37318 (J;US)
Mechanical properties of silica coatings, 15:37226 (R;US)
Mechanism of hydrodenitrogenation: Part 1, Preparation and characterization of acidic supports, 15:36696 (R;US)
SILICON
Anomalous elastic behavior in superlattices of twist grain boundaries in silicon, 15:37321 (J;US)
Defect relaxation in disordered materials: Stretched exponentials, Meyer-Neldel rule, and Staebler-Wronski effect, 15:37305 (BA;US)
Electron paramagnetic resonance and capacitance-voltage studies of ultraviolet irradiated Si-SiO_2 interfaces, 15:37309 (J;US)
Electron-beam assisted CVD of silicon homoepitaxial films, 15:37959 (BA;US)
Magic-angle spinning ^{29}Si NMR study of short-range order in a-Si, 15:37326 (J;US)
Observation of ballistic phonons in silicon crystals induced by α particles, 15:37317 (J;US)
Total dose radiation hardness of diamond-based silicon-on-insulator structures, 15:37315 (J;US)
SILICON 28 REACTIONS
$^{12}C(^{28}Si,X)^{11}C$ cross section at 13.4 GeV nucleon, 15:37861 (J;US)
SILICON 28 TARGET
Analysis of pion scattering to stretched states in ^{60}Ni and other nuclei using Woods-Saxon wave functions, 15:37854 (J;US)

SILICON 29
Magic-angle spinning ^{29}Si NMR study of short-range order in *a*-Si, 15:37326 (J;US)

SILICON CARBIDES
Laser ultrasonic measurements on ceramic materials with rough surfaces, 15:37232 (R;US)
Microvoids and photoconductivities in a-SiC:H and a-Si:H, 15:37306 (BA;US)
Silicon-carbide composite materials for the ARIES-I reactor study, 15:38216 (RA;US)
Synthesis of high purity sinterable silicon carbide powder: Final report, 15:37237 (R;US)
Vitreous joining of SiC fiber reinforced SiC composites, 15:37284 (R;US)

SILICON COMPOUNDS
See also SILANES
SILICON CARBIDES
SILICON FLUORIDES
SILICON OXIDES
Shape of the upper-critical-field curves in URu_2Si_2: Evidence for anisotropic pairing, 15:37986 (J;US)

SILICON FLUORIDES
Vibrational relaxation of highly excited SiF_4 and C_6F_5H by Ar, 15:37352 (J;US)

SILICON HYDRIDES
See SILANES

SILICON OXIDES
See also SILICA
Activation evaluation of fusion solid breeder materials, 15:38171 (RA;US)
Electron paramagnetic resonance and capacitance-voltage studies of ultraviolet irradiated Si-SiO_2 interfaces, 15:37309 (J;US)
Flashlamp-pumped dye and excimer laser planarization of thin metal films, 15:37957 (BA;US)
Mechanical properties of coatings and interfaces, 15:37225 (R;US)

SILICON SEMICONDUCTOR DETECTORS
See SI SEMICONDUCTOR DETECTORS

SILICON SOLAR CELLS
Application of InAlAs/GaAs superlattice alloys to GaAs solar cells, 15:37296 (R;US)
Direct measurement of the mobility-lifetime product of holes and electrons in an amorphous silicon p-i-n cell, 15:36839 (BA;US)
Hydrogen-plasma reactive flushing for a Si:H p-i-n solar cell fabrication, 15:36841 (BA;US)
Research on design and fabrication of high-efficiency solar cells, 15:37293 (R;US)
Stability, performance and trend modeling of amorphous silicon photovoltaic modules, 15:36840 (BA;US)
Thin film photovoltaic options: An overview, 15:36838 (BA;US)

SILVER IODIDES
Enhanced ionic conductivity in composite electrolytes, 15:37307 (BA;US)

SILVER SELENIDES
Molecular dynamics simulation of mass and charge transport in superionic conductors, and structural correlations in chalcogenide glasses, 15:37300 (BA;US)

SINTERING
Laser ultrasonic measurements on ceramic materials with rough surfaces, 15:37232 (R;US)
Real-time monitoring of ceramic sintering with laser ultrasonics, 15:37231 (R;US)

SKELETAL FOSSILS
See FOSSILS

SKYRMIONS
See SOLITONS

SLAGS
Experimental and theoretical investigation of the formation and growth of ash agglomerates: Final report, 15:36693 (R;US)

SLC
See STANFORD LINEAR COLLIDER

SLUGS (FUEL)
See FUEL RODS

SLURRIES
See also FUEL SLURRIES
Transport characteristics of concentrated slurries: Final technical report, 15:37386 (R;US)

SLURRIES (FUEL)
See FUEL SLURRIES

SMALL-SCALE HYDROELECTRIC POWER PLANTS
Inexpensive cross-flow hydropower turbine at the Arbuckle Mountain Hydroelectric Project: Field test report, 15:36826 (R;US)

SODIUM-WATER REACTIONS
See MOLTEN METAL-WATER REACTIONS

SOILING
See SURFACE CONTAMINATION

SOILS
Annual radiological environmental monitoring report, Watts Bar Nuclear Plant, 1989, 15:37581 (R;US)
Annual radiological environmental operating report, Browns Ferry Nuclear Plant, 1989, 15:37582 (R;US)
Annual radiological environmental operating report, Sequoyah Nuclear Plant, 1989, 15:37583 (R;US)
Crucible melts and bench-scale ISV [in situ vitrification] tests on simulated wastes in INEL [Idaho National Engineering Laboratory] soils, 15:36786 (R;US)
Initial tests on in situ vitrification using electrode feeding techniques, 15:36787 (R;US)
Off-Site Radiation Exposure Review Project: Phase 2 soils program: Revision, 15:37596 (R;US)
Radium contamination in the environment. January 1972-July 1989 (A Bibliography from Pollution Abstracts). Report for January 1972-July 1989, 15:37620 (R;US)
Viscosity, electrical conductivity, and cesium volatility of ORNL [Oak Ridge National Laboratory] vitrified soils with limestone and sodium additives, 15:36785 (R;US)

SOLAR ABSORBERS
Results of the design and testing of a porous ceramic absorber for a volumetric air receiver, 15:36846 (R;US)

SOLAR ACTIVITY
See also SOLAR WIND
Solar-Geophysical Data Number 546, February 1990. Part 1 (prompt reports). data for January 1990, December 1989, and late data, 15:37693 (R;US)
Solar-Geophysical Data Number 546, February 1990. Part 2 (comprehensive reports). Data for August 1989 and miscellaneous, 15:37694 (R;US)

SOLAR CELL RECEIVERS
See SOLAR RECEIVERS

SOLAR CELLS
See also ALUMINIUM ARSENIDE SOLAR CELLS
GALLIUM ARSENIDE SOLAR CELLS
ORGANIC SOLAR CELLS
SILICON SOLAR CELLS
Fabrication of minority-carrier-limited *n*-Si/insulator/metal diodes, 15:36842 (J;US)

SOLAR COLLECTORS
Experimental study of a self-pumping boiling collector solar hot water system, 15:36858 (J;US)

SOLAR CONCENTRATORS
See also SOLAR REFLECTORS
Performance testing and qualification of Sandia's third baseline photovoltaic concentrator module, 15:36837 (R;US)
Photovoltaic concentrator module technology, 15:36835 (R;US)
Reliability of photovoltaic concentrator modules, 15:36836 (R;US)

SOLAR ENERGY
Reflux pool-boiler as a heat-transport device for Stirling engines: On-sun test program results, 15:36847 (R;US)
The effects of urban air pollution on solar radiation, 15:36829 (R;US)

SOLAR ENERGY CONVERSION
See also SOLAR THERMAL CONVERSION
SERI Solar Radiation Resource Assessment Project: FY 1989 annual progress report, 15:36827 (R;US)

SOLAR HEATING SYSTEMS
See also PASSIVE SOLAR HEATING SYSTEMS

Cost requirements for solar thermal electric and industrial process heat, 15:36857 (BA;US)

SOLAR POWER PLANTS
See also PHOTOVOLTAIC POWER PLANTS
SOLAR THERMAL POWER PLANTS
Results of the design and testing of a porous ceramic absorber for a volumetric air receiver, 15:36846 (R;US)
Thin film photovoltaic options: An overview, 15:36838 (BA;US)

SOLAR RADIATION
SERI Solar Radiation Resource Assessment Project: FY 1989 annual progress report, 15:36827 (R;US)
Solar-Geophysical Data Number 546, February 1990. Part 2 (comprehensive reports). Data for August 1989 and miscellaneous, 15:37694 (R;US)
The effects of urban air pollution on solar radiation, 15:36829 (R;US)

SOLAR RECEIVERS
See also CENTRAL RECEIVERS
Reflux pool-boiler as a heat-transport device for Stirling engines: On-sun test program results, 15:36847 (R;US)
Trends in dish-Stirling solar receiver designs, 15:36859 (R;US)

SOLAR REFLECTORS
Trends in dish-Stirling solar receiver designs, 15:36859 (R;US)

SOLAR THERMAL CONVERSION
Research and development program on solar thermal use in the high temperature range, 15:36845 (R;DE;In German)

SOLAR THERMAL POWER PLANTS
Optimizing the value-to cost ratio for central receiver electric power plants, 15:36848 (J;US)
Trends in dish-Stirling solar receiver designs, 15:36859 (R;US)

SOLAR THERMAL RECEIVERS
See SOLAR RECEIVERS

SOLAR THERMAL TEST FACILITY
See CENTRAL RECEIVER TEST FACILITY

SOLAR WIND
Filamentation instability of MHD waves in solar wind plasma, 15:38055 (BA;US)

SOLID CLUSTERS
Vibrational properties of percolating clusters: Localization and density of states, 15:37975 (J;US)

SOLID STATE LASERS
See also NEODYMIUM LASERS
SEMICONDUCTOR LASERS
High-average-power solid state lasers, 15:38269 (RA;US)
Laser research and development, 15:38268 (RA;US)
Laser-diode-pumped, erbium-doped, solid-state laser with high slope efficiency, 15:37425 (P;US)

SOLID STATE PHYSICS
Solid state and materials research: Laser irradiation of solids, 15:37947 (RA;ZA)
Solid state and materials research: Laser irradiation of solids, 15:37949 (RA;ZA)
Solid state and materials research: Solid state interaction in thin-film semiconductor structures, 15:37948 (RA;ZA)
Solid state and materials research: Solid state interactions in thin-film structures, 15:37946 (RA;ZA)
The condensed matter physics, 15:37188 (R;FR;In French)

SOLIDS
Hopping model for the non-debye dielectric response in ionic crystals, 15:37302 (BA;US)
Semiclassical eigenenergies in the wake of fast ions in solids, 15:37943 (R;US)
Solid state mechanics, 15:37162 (R;FR;In French)
Stability of homogeneous-solid deflagration with two-phase flow in the reaction zone, 15:37390 (J;US)
Studies on the irradiated solids, 15:37369 (R;FR;In French)
The 12th Werner Brandt international conference on the penetration of charged particles in matter, 15:37942 (R;US)

SOLIDS FLOW
Advanced study in solid transport: Rheological behavior of dense suspension: Sixth quarterly report, January 1, 1990–March 31, 1990, 15:36711 (R;US)

SOLITONS
Effects of higher-order dispersion on envelope solitons, 15:38054 (BA;US)

SOLVENTS
Chlorinated hydrocarbon substitution program, 15:37283 (R;US)

SONDES
See PROBES

SORBENT INJECTION PROCESSES
Physical flow model study of the Ohio Power Company's 12-MW duct injection test facility in Beverly, Ohio: Topical report 10A, 15:36896 (R;US)
Simultaneous NO_x/SO_2 removal by the dry injection of lime-urea hydrate: Final report, 15:36897 (R;US)

SORPTION
Sandia Sorption Data Management System, Version 2 (SSDMS II): User's manual, 15:36788 (R;US)

SOUND
See SOUND WAVES

SOUND WAVES
Influence of anisotropy on the dispersion characteristics of guided ultrasonic plate modes, 15:37998 (J;US)

SOUTHEAST REGION
See FEDERAL REGION IV

SPACE HEATING
Heat pump and heliogeothermal space heating Aulnay-sous-Bois. The 1985 season, 15:36872 (R;FR;In French)
Wind heating feasibility, 15:36877 (R;FR;In French)

SPACE POWER REACTORS
Multimegawatt space nuclear power supply, Phase 1 Final report: Supplement D180-30619-8, 15:36931 (R;US)
Multimegawatt space nuclear power supply: Phase 1, Final report: Volume 2, Phase 2 plan, 15:36929 (R;US)
Multimegawatt space nuclear power supply: Phase 1, Final report: Volume 3, Annotated outline of preliminary safety assessment, 15:36930 (R;US)
Multimegawatt space power reactors, 15:36925 (R;US)
[Nuclear power engineering in space]: Foreign trip report, May 11, 1990–June 3, 1990, 15:36932 (R;US)

SPACE REFLECTION
See P INVARIANCE

SPACE SHUTTLES
Field experience in using laser acoustic sensing for inspection, 15:37394 (R;US)

SPACE VEHICLE COMPONENTS
Operational readiness review plan for the radioisotope thermoelectric generator materials production tasks, 15:37043 (R;US)

SPACE VEHICLES
See also SPACE SHUTTLES
1987 Strategic Defense Initiative Organization (SDIO) workshop on laser propulsion: Proceedings, 15:37138 (R;US)
Filamentation instability of MHD waves in solar wind plasma, 15:38055 (BA;US)
Fusion propulsion systems, 15:38114 (RA;US)
Multimegawatt space nuclear power supply, Phase 1 Final report: Supplement D180-30619-8, 15:36931 (R;US)
Multimegawatt space nuclear power supply: Phase 1, Final report: Volume 2, Phase 2 plan, 15:36929 (R;US)
Multimegawatt space nuclear power supply: Phase 1, Final report: Volume 3, Annotated outline of preliminary safety assessment, 15:36930 (R;US)
Operational readiness review plan for the radioisotope thermoelectric generator materials production tasks, 15:37043 (R;US)

SPECIFIC HEAT
Pressure dependence of the specific heat of heavy-fermion $YbCu_{4.5}$, 15:37979 (R;US)

SPECIFICATIONS
Verification of product quality from process control, 15:36776 (R;US)

SPECTROMETERS
See also GAMMA SPECTROMETERS
MAGNETIC SPECTROMETERS
MASS SPECTROMETERS
Proceedings of the second workshop of Japan-UK collaboration on neutron scattering research, 15:37945 (R;JP)

Program for preparing output data from a flow injection spectrometer for entry into AnaLis data base of the Analytical Chemistry Division, Oak Ridge National Laboratory, 15:37335 (R;US)

SPENT FUEL CASKS
Adsorption of spent fuel storage pool contaminants into metal surfaces, 15:37383 (R;US)
Doses to railroad workers exposed to shipments of high-level radioactive waste, 15:36804 (R;US)
Literature review of cask exterior surface contamination with application to a nuclear repository, 15:37379 (R;US)

SPENT FUELS
Classification of spent nuclear fuel (SNF), 15:36762 (R;US)
Doses to railroad workers exposed to shipments of high-level radioactive waste, 15:36804 (R;US)
The reaction of glass during gamma irradiation in a saturated tuff environment: Part 4, SRL 165, ATM-1c, and ATM-8 glasses at 1E3 R/h and O R/h, 15:36764 (R;US)
Transporting spent and damaged fuel in the United States: Recent experience and lessons learned related to the evolving transportation policy of the US Department of Energy, 15:36760 (R;US)

SPIN ORIENTATION
Consideration on feasibilities of double polarization experiments with polarized electron (or photon) beam and polarized target, 15:37486 (RA;JP)

SPIN-OFF
See TECHNOLOGY TRANSFER

SPIRAL ORBIT SPECTROMETERS
See FLAT MAGNETIC SPECTROMETERS

SPRAY DRYING
Spray-dryer flue-gas-cleaning systems handbook, 15:36892 (R;US)
User's guide for SDIS [Spray-Dryer Information System]: A personal computer code for the design and evaluation of spray-dryer flue-gas-cleaning systems, 15:36893 (R;US)

SQUID DEVICES
Superconducting thin-film multiturn coils of $YBa_2Cu_3O_{7-x}$, 15:37420 (J;US)

STAINLESS STEEL-18-4-1
See STAINLESS STEELS

STAINLESS STEEL-19-9DL
See STAINLESS STEELS

STAINLESS STEEL-304
Transactions of the 10th international conference on structural mechanics in reactor technology, 15:36990 (B;US)

STAINLESS STEEL-316
Effects of deformation (strain) and heat treatment on grain boundary sensitization and precipitation in austenitic stainless steels, 15:37203 (J;US)

STAINLESS STEELS
Aging considerations for pressurizers in nuclear power plants, 15:36993 (BA;US)
An initial comparison of pitting resistance of alloys for potential geothermal applications, 15:36869 (R;US)
Environmentally assisted cracking in light water reactors: Semiannual report, October 1988–March 1989: Volume 8, 15:36906 (R;US)
Oxidation and sulfidation of Type 310S stainless steel at elevated temperatures, 15:37183 (R;US)

STANDARD MODEL
Noodles and stars allow a precise and efficient calculation of the Z-line shape and the polarization asymmetry, 15:37796 (J;US)
Radiative corrections at SLC and LEP, 15:37797 (J;US)

STANDARDIZATION
Standardization of radioactivity, 15:37939 (RA;ZA)

STANDARDIZED TERMINOLOGY
Radiation protection glossary, 15:37936 (R;SY;In Arabic)

STANDARDS
Thermal effects on the Josephson series-array voltage standard, 15:37412 (R;US)

STANDING CROP
See BIOMASS

STANFORD LINEAR COLLIDER
Determination of ϵ, β, α from an arbitrary number of beam size measurements, 15:37459 (R;US)

STATES (ENERGY)
See ENERGY LEVELS

STATISTICAL MECHANICS
Determination of the order of phase transitions in numerical simulations, 15:37972 (J;US)

STATISTICS
Benchmarking of energy time series, 15:37008 (R;US)
[Optimal design and analysis of experiments]: Foreign trip report, July 16–August 5, 1988, 15:38324 (R;US)
[Optimal design and analysis of experiments]: Foreign trip report, July 22–29, 1988, 15:38323 (R;US)

STEAM GENERATORS
Eddy current inspection at the nuclear power plants, 15:37395 (R;FI;In Finnish)
MAAP [Modular Accident Analysis Program] steam generator modeling and benchmarking with Westinghouse MB-2 tests, 15:36968 (R;US)

STEAM SYSTEMS
A steam dispatching control system for Fort Benjamin Harrison, Indiana, 15:37135 (BA;US)

STEAM TURBINES
Utilization of off-peak electric power to improve cycle efficiency during peak demand periods, 15:36887 (R;US)

STEEL-000KH25
See STAINLESS STEELS

STEEL-000KH28
See STAINLESS STEELS

STEEL-00KH20N32T
See STAINLESS STEELS

STEEL-03KH13AG13
See STAINLESS STEELS

STEEL-0KH18G8N2T
See STAINLESS STEELS

STEEL-12KH2MV8FB
See STEELS

STEEL-12KH2V5FB
See STEELS

STEEL-18MNV6
See STEELS

STEEL-ASTM-A285
An initial comparison of pitting resistance of alloys for potential geothermal applications, 15:36869 (R;US)

STEEL-ASTM-A516
An investigation of amine-induced stress corrosion cracking of steels in natural gas treatment plants: Final report, 15:36744 (R;US)

STEELS
See also AUSTENITIC STEELS
A kinetic criterion for quasi-brittle fracture, 15:37208 (J;US)
An initial comparison of pitting resistance of alloys for potential geothermal applications, 15:36869 (R;US)
Ductile fracture properties of selected line-pipe steels, 15:36747 (R;US)
Investigation of sulfide-stress cracking at pipe seam welds, 15:36748 (R;US)
PR-EDB: Power Reactor Embrittlement Data Base, version 1: Program description, 15:36907 (R;US)
Review of procedures for welding onto pressurized pipelines: Final report: Volume 1, 15:36751 (R;US)
The significance of local hard zones on the outside of pipeline girth welds: Final report, 15:36735 (R;GB)
The use of flattened specimens to measure the Charpy V-notch impact properties of thin-wall pipe, 15:36746 (R;US)
Wide-plate crack-arrest tests utilizing prototypical and degraded (simulated) pressure vessel steels, 15:36995 (BA;US)

STELLARATORS
The role of stellarators in understanding toroidal transport physics, 15:38062 (BA;US)

STES
See SEASONAL THERMAL ENERGY STORAGE

STIRLING CYCLE
Dynamics of the Ross-Stirling engine, 15:37401 (R;CA)
Trends in dish-Stirling solar receiver designs, 15:36859 (R;US)
STIRLING ENGINES
A magnetically coupled Stirling engine driven heat pump: Design optimization and operating cost analysis, 15:37143 (R;US)
Dynamics of the Ross-Stirling engine, 15:37401 (R;CA)
Hardware development and initial subassembly test of a gas-fired Stirling/Rankine residential heat pump, 15:37145 (R;US)
Reflux pool-boiler as a heat-transport device for Stirling engines: On-sun test program results, 15:36847 (R;US)
Ross-Stirling engines: Variations on a theme, 15:37400 (R;CA)
STOCHASTIC PROCESSES
Scaling pattern of period doubling in four dimensions, 15:38004 (J;US)
STORAGE BATTERIES
See ELECTRIC BATTERIES
STORAGE FACILITIES
STL [Simulation Technology Laboratory] Global Control System, technical reference, 15:37499 (R;US)
Sampling plans to find faulty waste storage drums, 15:37377 (R;US)
STORAGE RINGS
See also HERA STORAGE RING
LEP STORAGE RINGS
PEP STORAGE RINGS
SUPERCONDUCTING SUPER COLLIDER
TRISTAN STORAGE RINGS
A fast injection system with a superconducting accumulator ring for a tau charm factory, 15:37502 (R;US)
A stochastic model of depolarization enhancement due to large energy spread in electron storage rings, 15:37457 (R;FR)
The physics of Beam Circulation Rings and their future aspects, 15:37509 (RA;JP;In Japanese)
STORES
See COMMERCIAL BUILDINGS
STRATEGIC DEFENSE INITIATIVE
See BALLISTIC MISSILE DEFENSE
STREAK CAMERAS
X-ray streak camera with 2 ps response, 15:37544 (J;US)
STREETS
See ROADS
STRENGTH (TENSILE)
See TENSILE PROPERTIES
STRING MODELS
Deformations of conformal field theories and symmetries of the string, 15:37819 (J;US)
Proceedings of the workshop 'topology, field theory and superstrings', 15:37806 (R;JP)
Supersymmetry breaking with vanishing cosmological constant in string theory, 15:37816 (J;US)
The bosonic string represented as ϕ^3 graphs: New Monte Carlo simulations, 15:37809 (R;DK)
STRONTIUM 82
Nuclear-structure effects in proton evaporation spectra, 15:37865 (J;US)
STRONTIUM 90
Interim report on low-cost cesium radiation sources from Hanford Waste Management Program, 15:36815 (R;US)
Operation of a mobile pilot-scale continuous countercurrent ion exchange system for treatment of low-level radioactive wastewaters, 15:36774 (R;US)
STRONTIUM BORIDES
Syntheses and crystal structures of the α- and β-forms of the orthoborate $Sr_2Cu(BO_3)_2$, 15:37175 (J;US)
STRONTIUM CHLORIDES
Crystal structure of $Sr_{10}Al_2F_{25}Cl$, 15:37173 (J;US)
STRONTIUM FLUORIDES
Crystal structure of $Na_3Sr_4Al_5F_{26}$, 15:37174 (J;US)
STRONTIUM OXIDES
Effect of microstructural changes on thermally activated flux-creep behavior in the Bi-Sr-Ca-Cu-O system, 15:37267 (J;US)
Strontium-induced oxygen defect structure and hole doping in $La_{2-x}Sr_xCuO_4$ (B), 15:37260 (J;US)
Thermal conductivity of single-crystal Bi-Sr-Ca-Cu-O, 15:37272 (J;US)
In situ processing of textured superconducting thin film of Bi(-Pb)-Ca-Sr-Cu-O by excimer laser ablation, 15:37256 (J;US)
STRUCTURAL BUCKLING
See DEFORMATION
STRUCTURAL MATERIALS
See BUILDING MATERIALS
STRUCTURES (BUILDINGS)
See BUILDINGS
STRUCTURES (MECHANICS)
See MECHANICAL STRUCTURES
STUDS
See FASTENERS
SUBMARINES
Three-dimensional parametric study for MHD marine propulsion, 15:37155 (R;US)
SUDDEN IONOSPHERIC DISTURBANCE
Solar-Geophysical Data Number 546, February 1990. Part 1 (prompt reports). data for January 1990, December 1989, and late data, 15:37693 (R;US)
SULFATES
Sixth annual Gatlinburg acid rain conference: Proceedings, 15:37679 (R;US)
SULFONATES
Role of specific solvation in the fluorescence sensitivity of 1,8-ANS to water, 15:37359 (J;US)
SULFUR 32 REACTIONS
Additional evidence for fusion-fission in $^{32}S+^{24}Mg$ reactions: Division of excitation energy and spin in the fission fragments, 15:37862 (J;US)
Experimental results concerning global observables from the CERN SPS heavy ion program, 15:37752 (R;US)
SULFUR 34 REACTIONS
Nuclear-structure effects in proton evaporation spectra, 15:37865 (J;US)
SULFUR CYCLE
Sulfur cycling and fluxes in temperate dimictic lakes, 15:37613 (R;US)
SULFUR DIOXIDE
Combined nitrogen oxides/sulfur dioxide control in a spray-dryer/fabric-filter system: Summary report for the Field Research Program, 15:36895 (R;US)
Combined nitrogen oxides/sulfur dioxide control in dry scrubber systems: Volume 2, Evaluation of additives and process modifications: Appendixes, 15:36894 (R;US)
EPA [Environmental Protection Agency] performance tests for particulate and SO_2 conducted at the DOE Coal-Fired Flow Facility, 15:37041 (R;US)
The greenhouse effect and acid rain: A tutorial, 15:37580 (R;US)
Theoretical approach for enhanced mass transfer effects in-duct flue gas desulfurization processes: Quarterly report No. 7, January 1, 1990–March 31, 1990, 15:36898 (R;US)
SULFUR FLUORIDES
Infrared radiation of SF_6 and its application to gas-filled double-pane windows, 15:37389 (J;US)
SULFUR OXIDES
See also SULFUR DIOXIDE
Cloud albedo, greenhouse effects, atmospheric chemistry, and climate change, 15:37590 (J;US)
SUNFLOWERS
Leaf magnesium alters photosynthetic response of low water potentials in sunflower, 15:37642 (J;US)
SUPERCONDUCTING CAVITY RESONATORS
Analysis and modelling of improved accelerating cavities for the Recirculating Linear Accelerator (RLA), 15:37458 (R;US)
Does UHV annealing above 1100C as a final surface treatment reduce field emission loading in superconducting cavities, 15:37470 (RA;US)
Prospects for RF application of high TC superconductors, 15:37467 (RA;US)
Requirements for longitudinal HOM damping in superconducting recirculating linacs, 15:37469 (RA;US)

Superconducting accelerating structures for high-current ion beams, 15:37466 (RA;US)

SUPERCONDUCTING COILS
Investigation of the mechanical properties of superconducting coils, 15:37405 (R;US)
Superconducting thin-film multiturn coils of $YBa_2Cu_3O_{7-x}$, 15:37420 (J;US)

SUPERCONDUCTING COMPOSITES
Trigonal phases in $YBa_2Cu_3O_{6.5}$, 15:37163 (J;US)
XPS study of the dependence on stoichiometry and interaction with water of copper and oxygen valence states in the $YBa_2Cu_3O_{7-x}$ compound, 15:37168 (J;US)

SUPERCONDUCTING DEVICES
See also SQUID DEVICES
SUPERCONDUCTING CAVITY RESONATORS
SUPERCONDUCTING MAGNETS
Principles of superconductor imaging surface gradiometry, 15:37978 (R;US)

SUPERCONDUCTING MAGNETS
Design study of the FER (fusion experimental reactor) superconducting magnet system, 15:38178 (RA;US)
Development of a forced-cooled superconducting coil for fusion applications, 15:38188 (RA;US)
Development of the proto-type conductors and design of the test coil for the fusion experimental reactor, 15:38098 (RA;US)
Experiments of the 1-m-bore, 30-kA superconducting demo poloidal coils, 15:38104 (RA;US)
Program CICC, flow and heat transfer in cable in conduit conductors (CICC), 15:38174 (RA;US)
Recommendations for a cryogenic system for ITER (International Thermonuclear Experimental Reactor), 15:38181 (RA;US)

SUPERCONDUCTING QUANTUM INTERFERENCE DEVICES
See SQUID DEVICES

SUPERCONDUCTING SUPER COLLIDER
Risks and benefits of building the superconducting super collider. Special study, 15:37442 (R;US)

SUPERCONDUCTING WIRES
Characterization of the strength and microstructural evolution of a heavily cold rolled Cu-20% Nb composite, 15:37254 (J;US)

SUPERCONDUCTORS
See also TYPE-II SUPERCONDUCTORS
Evidence of weak pair coupling in the penetration depth of bi-based high-T_c superconductors, 15:37976 (R;US)
Experiments on superconductor imaging surface magnetometry, 15:37406 (R;US)
Fermions and solitons in the O(3) nonlinear σ model in 2+1 space-time dimensions, 15:37983 (J;US)
High temperature superconducting compounds: Processing and related properties; Proceedings of the Symposium on High Temperature Superconducting Oxides: Processing and Related Properties, Las Vegas, NV, Feb. 27, 28, 1989, 15:37245 (B;US)
High-resolution Z-contrast imaging in the stem, 15:37941 (R;US)
Incoherent imaging of materials structure and composition by Z-contrast stem, 15:37281 (R;US)
Method for estimating failure probabilities of structural components and its application to fatigue problem of internally cooled superconductors, 15:38179 (RA;US)

SUPERFLUIDITY
Quantum turbulence, 15:37744 (J;US)

SUPERGRAVITY
Effective one-loop scalar Lagrangian in no-scale supergravity models, 15:37999 (J;US)

SUPERNOVAE
A site for the astrophysical gamma-ray process, 15:37696 (R;US)
Interpretation of the kinematical properties of SN 1987A neutrino data by an admixture of $\nu_\mu,\nu_{\tilde{\mu}}$ and $\nu_\tau,\nu_{\tilde{\tau}}$, 15:37701 (J;US)

SUPERSYMMETRY
Supersymmetry breaking with vanishing cosmological constant in string theory, 15:37816 (J;US)

SUPPORTS
See also FOUNDATIONS
Stress analysis of JT-60U tokamak, 15:38228 (RA;US)

SUPPORTS (CATALYST)
See CATALYST SUPPORTS

SURFACE CONTAMINATION
Literature review of cask exterior surface contamination with application to a nuclear repository, 15:37379 (R;US)

SURFACE PROPERTIES
Experiments on superconductor imaging surface magnetometry, 15:37406 (R;US)
Oxidation and sulfidation of Type 310S stainless steel at elevated temperatures, 15:37183 (R;US)

SURFACE-ACTIVE AGENTS
See SURFACTANTS

SURFACES
Selective electrocatalysis of anodic oxygen-transfer reactions at chemically modified, thin-film lead dioxide electrodes, 15:37235 (R;US)

SURFACTANTS
Propagation in an adsorbing porous medium of a mixture of anionic and non-ionic surfactants, 15:36725 (R;FR;In French)

SURVEYS
Outlook for ceramics in heat engines, 1990–2010: A technical and economic assessment based on a worldwide Delphi survey, 15:37156 (R;US)

SUSPENSIONS
See also SLURRIES
Bounds on the effective properties of polydispersed suspensions of spheres: An evaluation of two relevant morphological parameters, 15:37968 (J;US)
Observation of a phase transition in the sedimentation velocity of hard spheres, 15:37964 (J;US)

SUSPENSIONS (FUEL)
See FUEL SLURRIES

SWEDEN
SKB annual report 1988: Including summaries of technical reports issued during 1988, 15:36790 (R;SE)

SWITZERLAND
Filtered containment venting systems for Swiss LWR's - proposed design requirements and principles, 15:36976 (RA;US)

SYNCHROTRON RADIATION
Plans for production of undulator X-rays on AR and its applications to material and biological sciences, 15:37944 (R;JP;In Japanese)
The use of high-energy synchrotron radiation for x-ray scattering, 15:37510 (R;US)

SYNCHROTRON RADIATION SOURCES
See also KEK PHOTON FACTORY
Time resolved techniques: An overview, 15:37538 (R;US)

T

T INVARIANCE
Some issues in elementary particle physics involving low-energy neutrons and antiprotons focusing on measurement of violated symmetry, 15:37792 (RA;JP;In Japanese)

TANK FARMS
See STORAGE FACILITIES

TANKS
STL [Simulation Technology Laboratory] Global Control System, technical reference, 15:37499 (R;US)

TARGET CHAMBERS
Dose rate calculations for a light ion beam fusion Laboratory Microfusion Facility, 15:38233 (RA;US)

TARGETS
See also ALUMINIUM 27 TARGET
BERYLLIUM 9 TARGET
CARBON 12 TARGET
CARBON 14 TARGET
CHROMIUM 52 TARGET
COPPER 65 TARGET
CURIUM 248 TARGET
DEUTERIUM TARGET
GOLD 197 TARGET
HELIUM 3 TARGET

HELIUM 4 TARGET
HYDROGEN 1 TARGET
IRON 54 TARGET
LANTHANUM 139 TARGET
LASER TARGETS
LEAD 208 TARGET
LITHIUM 6 TARGET
LITHIUM 7 TARGET
MAGNESIUM 24 TARGET
NICKEL 58 TARGET
NICKEL 60 TARGET
NIOBIUM 93 TARGET
OXYGEN 16 TARGET
PLUTONIUM 239 TARGET
POLARIZED TARGETS
SILICON 28 TARGET
TERBIUM 159 TARGET
TIN 120 TARGET
URANIUM 235 TARGET
URANIUM 238 TARGET
ZIRCONIUM 90 TARGET

Problems of thermal engineering in target cooling, 15:37387 (RA;JP;In Japanese)

TAU LEPTONS
See TAU PARTICLES

TAU PARTICLES
Production and decay of the τ lepton, 15:37777 (R;DE;In German)

TAUONS
See TAU PARTICLES

TECHNETIUM 99
Improved method for the direct labeling of antibodies with Tc-99m, 15:37647 (R;US)
One step Tc-99m labeling of antibodies for use in inflammation imaging, 15:37646 (R;US)

TECHNICAL SPECIFICATIONS
See SPECIFICATIONS

TECHNOLOGY TRANSFER
It's not hype, it's communication: Using public relations techniques to improve your technical messages, 15:38344 (R;US)

TELEVISION
Development and field testing of the high-temperature borehole televiewer, 15:37536 (R;US)

TEMPERATURE MONITORING
TFTR neutral beam automated thermocouple monitor, 15:38246 (RA;US)

TENNESSEE VALLEY AUTHORITY
Integrated regional resources management: Based on the experience of the Tennessee Valley Authority, 15:37018 (R;US)

TENNESSEE VALLEY REGION
Integrated regional resources management: Based on the experience of the Tennessee Valley Authority, 15:37018 (R;US)

TENSILE PROPERTIES
A modified criterion for evaluating the remaining strength of corroded pipe: Final report, 15:36749 (R;US)

TENSILE STRENGTH
See TENSILE PROPERTIES

TERBIUM 159 TARGET
Thermal and angular momentum effects in the giant-dipole-resonance decay of hot rare-earth nuclei, 15:37877 (J;US)

TERNARY ALLOY SYSTEMS
Equal eigenvalues in multicomponent diffusion: The extraction of diffusion coefficients from experimental data in ternary systems, 15:37955 (R;US)

TERRESTRIAL BACKGROUND
See BACKGROUND RADIATION

TERRESTRIAL ECOSYSTEMS
Acidic deposition on Walker Branch Watershed, 15:37606 (BA;US)
Review of the chronic exposure pathways models in MACCS [MELCOR Accident Consequence Code System] and several other well-known probabilistic risk assessment models, 15:37599 (R;US)

TERTIARY RECOVERY
See ENHANCED RECOVERY

TEST FACILITIES
See also CENTRAL RECEIVER TEST FACILITY
TRITIUM SYSTEMS TEST ASSEMBLY
Long-term fate of depleted uranium at Aberdeen and Yuma Proving Grounds: Final report, Phase 1: Geochemical transport and modeling, 15:36795 (R;US)

TESTING
See also MATERIALS TESTING
Objectives, specification and elaboration of technical scenarios for emergency drills involving a French PWR, 15:36908 (R;FR)

TESTING (MATERIALS)
See MATERIALS TESTING

TETRAGONAL LATTICES
Coarsening kinetics of the tetragonal phase in a manganesia-partially-stabilized zirconia, 15:37257 (J;US)

TEXAS EXPERIMENTAL TOKAMAK
See TEXT DEVICES

TEXT DEVICES
Control system for the Texas Experimental Tokamak ECRH system, 15:38242 (RA;US)
Design studies of the 2 mev heavy ion beam probe for text upgrade, 15:38073 (BA;US)
Poloidal field electromagnetic engineering design for the TEXT upgrade, 15:38302 (BA;US)
Texas experimental tokamak electron cyclotron resonant heating system, 15:38235 (RA;US)
The design of a 400 kV parallel plate electrostatic analyzer for use with the 2 MeV heavy ion beam probe, 15:38082 (BA;US)

TEXTOR TOKAMAK
Neutral injection for TEXTOR, 15:38143 (RA;US)

TFTR DEVICE
See TFTR TOKAMAK

TFTR REACTORS
See TFTR TOKAMAK

TFTR TOKAMAK
Alignment of the TFTR bumper limiter, 15:38147 (RA;US)
Design considerations for penetrations in the TFTR radiation shield, 15:38214 (RA;US)
Emergency operations procedures development and training, 15:38254 (RA;US)
Gas handling for the Tokamak Fusion Test Reactor during the DT phase of operation: System overview, 15:38136 (RA;US)
Measurement of iron transport in TFTR [Tokamak Fusion Test Reactor] by charge exchange recombination spectroscopy, 15:38036 (R;US)
Measurements of radial profiles of He^{2+} transport coefficients on TFTR [Tokamak Fusion Test Reactor], 15:38034 (R;US)
Neutral beam emission spectroscopy diagnostic for measurement of density fluctuations on the TFTR tokamak, 15:38033 (R;US)
Oil as an alternative coolant for use in the TFTR toroidal field coils, 15:38185 (RA;US)
Pellets in large tokamaks TFTR and JET, 15:38255 (R;US)
Radiation safety management during a TFTR shutdown, 15:38249 (RA;US)
Radiation shielding for TFTR D-T operation, 15:38125 (RA;US)
TFTR CAMAC power supplies reliability, 15:38109 (RA;US)
TFTR TF coil thermal analysis and test, 15:38186 (RA;US)
TFTR neutral beam automated thermocouple monitor, 15:38246 (RA;US)
TFTR neutral beam bellows redesign and calorimeter upgrade, 15:38241 (RA;US)
The use of Computer Aided Management of Emergency Operations (CAMEO) at the Tokamak Fusion Test Reactor (TFTR), 15:38250 (RA;US)
The use of cryopumps for impurity pumping during the TFTR D-T phase, 15:38138 (RA;US)
Thermal and stress analysis of the Faraday shield for the ORNL/TFTR RF antenna, 15:38237 (RA;US)

THALLIUM 201
Standardization of radioactivity, 15:37939 (RA;ZA)

THALLIUM ALLOYS
Twin boundaries, interfaces and modulated structures in martensites: Annual progress report No. 5, July 1, 1989–June 30, 1990, 15:37184 (R;US)

THALLIUM OXIDES
Strongly enhanced flux pinning by high-energy proton irradiation of a $Tl_2Ca_2Ba_2Cu_3O_y$ single crystal, 15:37258 (J;US)
THERAPEUTIC AGENTS
See DRUGS
THERMAL DECOMPOSITION
See PYROLYSIS
THERMAL ENERGY STORAGE EQUIPMENT
Boiling/evaporative heat transfer from spheres in packed-bed thermal energy storage units: Final report, 15:37000 (R;US)
Commercial cool storage laboratory test procedure, 15:37001 (R;US)
THERMAL ENVELOPE HOUSES
See DOUBLE ENVELOPE BUILDINGS
THERMAL INSULATION
Assessment of the energy conservation potential of active (variable thermal resistance and switchable absorptance) building thermal insulation systems, 15:37124 (R;US)
Chlorofluorocarbon (CFC) technologies review of foamed-board insulation for buildings, 15:37123 (R;US)
THERMAL NEUTRONS
An accelerator neutron source for BNCT [Boron Neutron Capture Therapy]: Progress report, 15 July 1989–15 March 1990, 15:37644 (R;US)
Neutron interference experiment and quantum-mechanical observation problem, 15:37924 (RA;JP;In Japanese)
THERMAL POLLUTION (AIR)
See AIR POLLUTION
THERMAL REACTORS
See also ARDENNES REACTOR
CHERNOBYLSK-4 REACTOR
THREE MILE ISLAND-2 REACTOR
[Thermal reactor safety]: Foreign trip report, October 2–13, 1988, 15:36986 (R;US)
THERMAL SHIELDS
Field experience in using laser acoustic sensing for inspection, 15:37394 (R;US)
THERMIONIC DIODES
Characterization of the time-evolution of a microsecond electron beam diode with anode effects, 15:38072 (BA;US)
THERMODYNAMICS
A lattice gas model for thermohydrodynamics, 15:37740 (R;US)
THERMOELECTRIC CELLS
See THERMOELECTRIC GENERATORS
THERMOELECTRIC CONVERTERS
See THERMOELECTRIC GENERATORS
THERMOELECTRIC GENERATORS
Operational readiness review plan for the radioisotope thermoelectric generator materials production tasks, 15:37043 (R;US)
THERMOELECTRIC REFRIGERATORS
On the use of oxides for thermoelectric refrigeration, 15:37042 (R;GB)
THERMONUCLEAR DEVICES
See also ICF DEVICES
PINCH DEVICES
COMPASS electrical systems and commissioning, 15:38112 (RA;US)
Development of the proto-type conductors and design of the test coil for the fusion experimental reactor, 15:38098 (RA;US)
Location and repair of air leaks in the ATF vacuum vessel, 15:38140 (RA;US)
The RFX pulse transmission network, 15:38205 (RA;US)
THERMONUCLEAR FUELS
The effects of exchange gas temperature and pressure on the beta-layering process in solid deuterium-tritium fusion fuel, 15:38260 (R;US)
THERMONUCLEAR IGNITION
Analysis of the small and large versions of the IGNITEX experiment, 15:38193 (RA;US)
Basis, description, and objectives of the IGNITEX experiment, 15:38202 (RA;US)
Experimental program and diagnostics for IGNITEX, 15:38015 (RA;US)
Fusion physics study of the IGNITEX experiment, 15:38011 (RA;US)
Preliminary estimate of the cost breakdown for the fusion ignition experiment IGNITEX, 15:38207 (RA;US)
THERMONUCLEAR REACTIONS
Cold fusion studies: Part 1, Preliminary results from an investigation of the possibility of electrochemically induced fusion of deuterium in palladium and titanium cathodes, 15:38007 (R;US)
Improvements in microchannel plate operating characteristics, 15:38074 (BA;US)
THERMONUCLEAR REACTOR COOLING SYSTEMS
Liquid metal mist cooling and MHD Ericsson cycle for fusion energy conversion, 15:38122 (RA;US)
Liquid nitrogen cooling for the compact ignition tokamak, 15:38182 (RA;US)
Preliminary design of the CIT cryostat, 15:38183 (RA;US)
THERMONUCLEAR REACTOR FUELING
Eight-shot pneumatic pellet injector for the Advanced Toroidal Facility, 15:38208 (RA;US)
The ORNL (Oak Ridge National Laboratory) plasma fueling program, 15:38204 (RA;US)
Tritium proof-of-principle pellet injector results, 15:38196 (RA;US)
THERMONUCLEAR REACTOR MATERIALS
Combustion testing and thermal modeling of proposed CIT [Compact Ignition Tokamak] graphite tile materials, 15:38257 (R;US)
Metal/graphite - composites in fusion engineering, 15:38134 (RA;US)
THERMONUCLEAR REACTORS
See also D-T REACTORS
ION BEAM FUSION REACTORS
LASER FUSION REACTORS
MAGNETIC MIRROR TYPE REACTORS
PULSED FUSION REACTORS
TOKAMAK TYPE REACTORS
A plan for the study of the costs and environmental impact of fusion compared with alternative energy sources: Final report, 15:38274 (R;US)
Ball lightning as a route to fusion energy, 15:38232 (RA;US)
Development of a forced-cooled superconducting coil for fusion applications, 15:38188 (RA;US)
Fusion propulsion systems, 15:38114 (RA;US)
GlidCop dispersion strengthened copper: Potential applications in fusion power generators, 15:38103 (RA;US)
ICF applications studies, 15:38270 (RA;US)
Identification and selection of initiating events for experimental fusion facilities, 15:38168 (RA;US)
Liquid metal mist cooling and MHD Ericsson cycle for fusion energy conversion, 15:38122 (RA;US)
Numerical simulation of turbulent gas-particle fluid flow and heat transfer, 15:38120 (RA;US)
THESAURI
See STANDARDIZED TERMINOLOGY
THIN FILMS
Design and fabrication of high damage threshold turning mirrors for the Nova laser, 15:37244 (R;US)
Electron-beam assisted CVD of silicon homoepitaxial films, 15:37959 (BA;US)
Flashlamp-pumped dye and excimer laser planarization of thin metal films, 15:37957 (BA;US)
Infrared reflectance properties of surface thin films, 15:37218 (J;US)
Potential applications of an electron cyclotron resonance multicusp plasma source, 15:37716 (R;US)
Process margins for laser planarization of 1 to 5 μm gold films, 15:37958 (BA;US)
Pulsed-laser evaporation technique for deposition of thin films: Physics and theoretical model, 15:37971 (J;US)
Thin film photovoltaic options: An overview, 15:36838 (BA;US)
Wear mechanisms of amorphous carbon and zirconia coatings on rigid disk magnetic recording media, 15:37241 (R;US)
THORIUM
Study of the mechanism of fast diffusion of cobalt in thorium by diffusion and internal friction measurements, 15:37210 (J;US)

THORIUM 229
High resolution measurements of mass, energy and nuclear charge correlations for ^{229}Th (n_{th}, f) with the Cosi Fan Tutte spectrometer, 15:37892 (R;FR)

THORIUM 232
Classical model for α-particle emission during nuclear fission, 15:37891 (R;FR)

THORIUM CHLORIDES
High-temperature equilibrium studies of the gaseous thorium chlorides, 15:37353 (J;US)

THORIUM D
See LEAD 208

THREE MILE ISLAND-2 REACTOR
Review of the state of criticality of the Three Mile Island Unit 2 core and reactor vessel, 15:36966 (R;US)
Simulation of Phases 3 and 4 of the TMI-2 accident using MAAP-DOE and MAAP 3.0B, Task 3.9, 15:36964 (R;US)

TIME-REVERSAL INVARIANCE
See T INVARIANCE

TIN 110
Deformation effects in the compound nucleus decay using the spin-alignment method, 15:37871 (J;US)

TIN 114
Deformation effects in the compound nucleus decay using the spin-alignment method, 15:37871 (J;US)

TIN 120 TARGET
Analyzing power measurements for elastic scattering of 17 MeV neutrons from ^{120}Sn, 15:37872 (J;US)

TIN ALLOYS
Magnetic excitations in USn_3, 15:37222 (J;US)

TISSUE EXTRACTS
Isolation and radioprotective assays of tissue inhibitory factors, 15:37664 (R;CN;In Chinese)

TITANATES
The effects of hydrolysis and additive conditions on the gel-to-ceramic conversion of sol-gel derived $PbTiO_3$, 15:37240 (R;US)

TITANIUM
An initial comparison of pitting resistance of alloys for potential geothermal applications, 15:36869 (R;US)

TITANIUM 44
Half-lives of ^{44}Ti and ^{207}Bi, 15:37867 (J;US)

TITANIUM ALLOYS
See also ALLOY-NI73CR15FE7TI3
TITANIUM BASE ALLOYS
Crystal growth and deformation behavior of TiAl aluminides, 15:37193 (R;US)
Deposition and adhesion of PECVD boron coatings on Ti-6Al-4V substrates, 15:37202 (BA;US)
Formation of cubic Ll_2 phases from Al_3Ti and Al_3Zr by transition metal substitutions for Al, 15:37180 (R;US)

TITANIUM BASE ALLOYS
Compendium of material test results on HY-130 and Ti-3Al-2V metals in support of United States Navy programs: Interim report, 15:37197 (R;US)

TITANIUM BORIDES
Weldability of iron aluminides, 15:36691 (R;US)

TITANIUM OXIDES
Engineering-scale experiments of solar photocatalytic oxidation of trichloroethylene, 15:36856 (R;US)
Intrinsic fast oxygen ionic conductivity in the $Gd_2(Zr_xTi_{1-x})_2O_7$ and $Y_2(Zr_xTi_{1-x})_2O_7$ pyrochlore systems, 15:37246 (BA;US)

TITANIUM SULFIDES
Properties of electrolyte and electrode films prepared by rf and dc magnetron sputtering, 15:37247 (BA;US)

TMX DEVICES
Radial ion diffusion induced by cyclotron resonance heating at the thermal barrier region in the Phaedrus-B Tandem Mirror, 15:38087 (BA;US)

TNT
An evaluation of the environmental fate and behavior of munitions materiel (TNT, RDX) in soil and plant systems: Environmental fate and behavior of TNT [trinitrotoluene]: Final report, 15:37687 (R;US)
TNT [trinitrotoluene] metabolites in animal tissues: Quarterly technical progress report No. 6, January 1–March 31, 1990, 15:37676 (R;US)

TOKAMAK DEVICES
See also ALCATOR DEVICE
COMPACT IGNITION TOKAMAK
FT TOKAMAK
ITER TOKAMAK
JXFR TOKAMAK
PBX DEVICES
TEXT DEVICES
TEXTOR TOKAMAK

Beam Injection
Assessment of possible high-energy neutral beam injection in DIII-D, 15:38010 (RA;US)

Beam Transport
Microwave transport system for the MTX, 15:38161 (RA;US)

Biological Shielding
Neutron shielding system for the DIII-D research facility, 15:38227 (RA;US)

Biological Shields
Radiation shielding analysis for DIII-D, 15:38118 (RA;US)

Cost
Preliminary estimate of the cost breakdown for the fusion ignition experiment IGNITEX, 15:38207 (RA;US)

Current-Drive Heating
Current drive by spheromak injection into a tokamak, 15:38090 (J;US)

Design
Analysis of the small and large versions of the IGNITEX experiment, 15:38193 (RA;US)
Basis, description, and objectives of the IGNITEX experiment, 15:38202 (RA;US)
Design of the start experiment, 15:38117 (RA;US)
Microwave Tokamak Experiment: An overview of the construction and checkout phase, 15:38165 (RA;US)

Divertors
Design of DIII-D advanced divertor, 15:38211 (RA;US)
Thermal design and analysis of DIII-D advanced divertor, 15:38133 (RA;US)

Ecr Heating
Microwave Tokamak Experiment: An overview of the construction and checkout phase, 15:38165 (RA;US)

First Wall
Impurity release disruption effects, and thermomechanical stress analysis of the first wall system for the IGNITEX experiment, 15:38130 (RA;US)
Modeling of runaway electron damage for the design of tokamak plasma facing components, 15:38148 (RA;US)

H-Mode Plasma Confinement
The effect of the radial electric field on the L-H mode transition in Tokamaks, 15:38047 (R;SE)

Heating Systems
Microwave Tokamak Experiment (MTX) ohmic heating system, 15:38220 (RA;US)

Impurities
Impurity release disruption effects, and thermomechanical stress analysis of the first wall system for the IGNITEX experiment, 15:38130 (RA;US)

Limiters
Modeling of runaway electron damage for the design of tokamak plasma facing components, 15:38148 (RA;US)

Magnets
Analysis of the poloidal field system leads in the IGNITEX experiment, 15:38116 (RA;US)
DIII-D F-coil chopper selection, control and fault recognition system, 15:38229 (RA;US)
Electromechanical analysis of a prototype 20 TESLA, single turn toroidal field coil for IGNITEX, 15:38175 (RA;US)
Optimization of the poloidal transformer of ignitor, 15:38184 (RA;US)

Mhd Equilibrium
Structural eddy current effects on plasma equilibrium and current induction in the IGNITEX experiment, 15:38008 (RA;US)

Microwave Heating
MTX [Microwave Tokamak Experiment] diagnostics and timing system for FEL [free electron laser] heating experiments: Revision 1, 15:38276 (R;US)
Neutral Beam Sources
Beam current regulation of DIII-D neutral beam long pulse ion sources, 15:38142 (RA;US)
PC-Link historical data base system MODCOMP/IBM at link for neutral particle beam operation, 15:38243 (RA;US)
Operation
Microwave Tokamak Experiment (MTX) first year of operation and future plans, 15:38166 (RA;US)
Pellet Injection
Application of the results of carbon pellet modeling to the problem of plasma penetration, 15:38017 (R;US)
Planning
Microwave Tokamak Experiment (MTX) first year of operation and future plans, 15:38166 (RA;US)
Plasma Confinement
Neoclassical transport of toroidal momentum in tokamaks, 15:38091 (J;US)
Plasma Diagnostics
Experimental program and diagnostics for IGNITEX, 15:38015 (RA;US)
MTX [Microwave Tokamak Experiment] data acquisition and analysis computer network: Revision 1, 15:38053 (R;US)
Start-effect measurement of high FEL [free-electron laser] electric fields in MTX [Microwave Tokamak Experiment] by laser-aided particle-probe spectroscopy, 15:38052 (R;US)
Plasma Heating
Microwave transport system for the MTX, 15:38161 (RA;US)
Plasma Production
Cavity resonance mode plasma breakdown for the IGNITEX experiment, 15:38009 (RA;US)
Plasma Simulation
Experimental and theoretical modeling of runaway electron damage for the design of tokamak plasma facing components, 15:38292 (BA;US)
Poloidal Field Divertors
Poloidal rotation asymmetry and electric field effects at the edge of a divertor TOKAMAK, 15:38042 (R;SE)
Shielding
Multidimensional radiation analysis for the fusion ignition experiment IGNITEX, 15:38215 (RA;US)
Turbulence
Effect of the radial electric field on turbulence, 15:38018 (R;US)

TOKAMAK FUSION TEST REACTOR
See TFTR TOKAMAK

TOKAMAK TYPE REACTORS
See also COMPACT IGNITION TOKAMAK
JET TOKAMAK
JT-60 TOKAMAK
TFTR TOKAMAK
Breeding Blankets
Blanket design for the ARIES-I tokamak reactor, 15:38154 (RA;US)
Silicon-carbide composite materials for the ARIES-I reactor study, 15:38216 (RA;US)
Current-Drive Heating
High energy (1-2 MeV) beams for magnetic fusion - tokamak plasma heating and current drive, 15:37432 (RA;US)
Design
Apollo-L2, an advanced fuel tokamak reactor utilizing direct conversion, 15:38163 (RA;US)
Design integration of the ARIES-I tokamak reactor, 15:38153 (RA;US)
MHD equilibrium and stability considerations for high-aspect-ratio ARIES-I tokamak reactors, 15:38014 (RA;US)
The ARIES tokamak fusion reactor study, 15:38151 (RA;US)
The ARIES-I high-field-tokamak reactor: Design-point determination and parametric studies, 15:38152 (RA;US)
Vertical stability requirements for ARIES-1 reactor, 15:38145 (RA;US)
Energy Conversion
Energy conversion options for ARIES-III - A conceptual D-^{3}He tokamak reactor, 15:38155 (RA;US)
Study of an advanced D-T tokamak fusion reactor with compact fusion advanced rankine (CFAR) cycle, 15:38224 (RA;US)
First Wall
Silicon-carbide composite materials for the ARIES-I reactor study, 15:38216 (RA;US)
Magnets
Center conductor design for the compact Spherical Torus reactor, 15:38126 (RA;US)
Vertical stability requirements for ARIES-1 reactor, 15:38145 (RA;US)
Mhd Equilibrium
MHD equilibrium and stability considerations for high-aspect-ratio ARIES-I tokamak reactors, 15:38014 (RA;US)
Neutral Beam Sources
High energy (1-2 MeV) beams for magnetic fusion - tokamak plasma heating and current drive, 15:37432 (RA;US)
Plasma Instability
MHD equilibrium and stability considerations for high-aspect-ratio ARIES-I tokamak reactors, 15:38014 (RA;US)
Radiation Hazards
An estimation of radiological hazards of current tokamak reactor concepts, 15:38170 (RA;US)
Risk Assessment
Risk evaluation of the in-vessel plant area of a net type tokamak machine: Direct, induced and common cause failures, 15:38169 (RA;US)
Superconducting Magnets
Program CICC, flow and heat transfer in cable in conduit conductors (CICC), 15:38174 (RA;US)
Thermonuclear Reactor Fueling
Pellet fueling of helium-3 enclosed in Li and Be shells, 15:38199 (RA;US)

TOOLS (EDUCATIONAL)
See EDUCATIONAL TOOLS

TOP PARTICLES
A new limit on the mass of the top quark, 15:37758 (R;US)
The search of the top quark in the UA2' experiment, 15:37770 (R;FR;In French)

TORI
See also COMPACT TORUS
CPRF/ZTH front-end torus design and fabrication status, 15:38111 (RA;US)

TOROIDAL THETA PINCH DEVICES
The role of stellarators in understanding toroidal transport physics, 15:38062 (BA;US)

TOTAL-ABSORPTION SPECTROMETERS
See SHOWER COUNTERS

TRACE ELEMENTS
See ELEMENTS

TRAFFIC CONTROL
Feasibility of exclusive facilities for cars and trucks: Final report, 15:37140 (R;US)

TRAINING
Emergency preparedness at Oak Ridge National Laboratory, Oak Ridge, Tennessee, 15:36796 (R;US)

TRAINING-RESEARCH REACTOR KYOTO
See KUR REACTOR

TRANSFER (HEAT)
See HEAT TRANSFER

TRANSFER (IN ENVIRONMENT)
See RADIONUCLIDE MIGRATION

TRANSFORMERS
Optimization of the poloidal transformer of ignitor, 15:38184 (RA;US)

TRANSISTORS
See also FIELD EFFECT TRANSISTORS
Effect of temperature on data retention of silicon-oxide-nitride-oxide-semiconductor nonvolatile memory transistors, 15:37424 (J;US)

TRANSITION ELEMENT ALLOYS
Formation of cubic Ll_2 phases from Al_3Ti and Al_3Zr by transition metal substitutions for Al, 15:37180 (R;US)

TRANSITION ELEMENTS
See also COBALT
COPPER
GOLD
IRON
MOLYBDENUM
NICKEL
TITANIUM
VANADIUM
Relativistic effects on the $s \rightarrow d$ promotion energy and spin-polarization energy of the transition metals, 15:37724 (J;US)
The phosphorus and the transition metals chemistry, 15:37345 (R;FR;In French)

TRANSITION FLOW
Theoretical studies on the role of transition in determining friction and heat transfer in smooth and rough passages: Final report, 15:37374 (R;US)

TRANSITION METALS
See TRANSITION ELEMENTS

TRANSMISSION (HEAT)
See HEAT TRANSFER

TRANSMISSION LINES
See POWER TRANSMISSION LINES

TRANSMISSION TOWERS
See POWER TRANSMISSION TOWERS

TRANSPORT
See also WASTE TRANSPORTATION
Incorporation of an explosive cloud rise code into ARAC's [Atmospheric Release Advisory Capability] ADPIC transport and diffusion model, 15:37588 (R;US)

TRANSPORT (CHARGED-PARTICLE)
See CHARGED-PARTICLE TRANSPORT

TRANSPORT (NEUTRON)
See NEUTRON TRANSPORT

TRANSPORTATION ROUTES
See ROUTING

TRANSURANIUM WASTES
See ALPHA-BEARING WASTES

TRAPPED ELECTRONS
Two theories of auroral electron acceleration, 15:37705 (R;GB)

TREES
See also OAKS
PINES
Constraints on tree breeding: Growth tradeoffs, growth strategies, and defensive investments, 15:37610 (J;US)
Substrate heterogeneity and regeneration of a swamp tree, Nyssa aquatica, 15:37608 (J;US)

TRIBOLOGY
Tribology: Coatings. October 1976-March 1990 (A Bibliography from the COMPENDEX data base). Report for October 1976-March 1990, 15:37153 (R;US)

TRICHLOROMETHANE
See CHLOROFORM

TRINITROTOLUENE
See TNT

TRISTAN PROJECT
See TRISTAN STORAGE RINGS

TRISTAN STORAGE RINGS
Prospect of electron polarization at TRISTAN, 15:37508 (RA;JP)

TRITIUM
Advanced hydride laboratory, 15:36820 (BA;US)
Co-pumping of deuterium-helium and tritium-helium mixtures at TSTA, 15:38135 (RA;US)
Dispersion and removal of tritium released into the main cell of TSTA, 15:38102 (RA;US)
Fusion fuel purification during the Tritium Systems Test Assembly 3-week loop experiment, 15:38101 (RA;US)
Gas handling for the Tokamak Fusion Test Reactor during the DT phase of operation: System overview, 15:38136 (RA;US)
Nuclear charge symmetry breaking and quantum-chromodynamically-induced corrections to quantum electrodynamics, 15:37917 (J;US)
Onsite environmental report for the Nevada Test Site, January 1988–December 1988, 15:37567 (R;US)
Operation of the tritium process laboratory (TPL) in the Japan Atomic Energy Research Institute, 15:38106 (RA;US)
Physics study of the application of an IFEL [Induction Free-Electron Laser] to CIT [Compact Ignition Tokamak]: Interim report, 15:38275 (R;US)
Tritium analysis of a water-cooled solid breeder blanket for ITER, 15:38121 (RA;US)
Uranium storage bed accident hazards evaluation, 15:38107 (RA;US)
dc electrical conductivity of D-T gas, 15:37319 (J;US)

TRITIUM SYSTEMS TEST ASSEMBLY
Co-pumping of deuterium-helium and tritium-helium mixtures at TSTA, 15:38135 (RA;US)
Dispersion and removal of tritium released into the main cell of TSTA, 15:38102 (RA;US)
Fusion fuel purification during the Tritium Systems Test Assembly 3-week loop experiment, 15:38101 (RA;US)
The breeding blanket interface (BBI) and the tritium systems test assembly (TSTA), 15:38105 (RA;US)

TRITONS
Hypertriton: $\Lambda \leftrightarrow \Sigma$ conversion and tensor forces, 15:37918 (J;US)
Is there any quark effect seen in triton?, 15:37793 (RA;JP)

TRU WASTES
See ALPHA-BEARING WASTES

TRUCKS
Light-duty vehicle MPG [miles per gallon] and market shares report, Model year 1989, 15:37139 (R;US)

TRX-1
See REVERSE-FIELD PINCH

TSCHEBYSCHEFF APPROXIMATION
See POLYNOMIALS

TSTA
See TRITIUM SYSTEMS TEST ASSEMBLY

TUBES
Theoretical studies on the role of transition in determining friction and heat transfer in smooth and rough passages: Final report, 15:37374 (R;US)

TUBES (CONDUITS)
See PIPES

TUFF
Stratigraphic correlation and petrography of the bedded tuffs, Yucca Mountain, Nye County, Nevada, 15:37690 (R;US)
The reaction of glass during gamma irradiation in a saturated tuff environment: Part 4, SRL 165, ATM-1c, and ATM-8 glasses at 1E3 R/h and O R/h, 15:36764 (R;US)

TUMORS
See NEOPLASMS

TUNGSTEN ALLOYS
See also TUNGSTEN BRONZE
Enhanced ordering and stability of Pd_8W in proton irradiated Pd-W alloys, 15:37206 (J;US)

TUNGSTEN BRONZE
Quasi-two-dimensional electronic properties of the monophosphate tungsten bronzes $Na_xP_4W_8O_{32}$ and $Na_xP_4W_{12}O_{44}$: Crystal growth, physical properties, and electronic band structure, 15:37164 (J;US)

TUNGSTEN COMPLEXES
The reactivity of the thioalkyne, $MeSC{\equiv}CSMe$, with ruthenium and tungsten complexes, 15:37351 (R;US)

TURBINE BLADES
Coatings for high temperature corrosion in aero and industrial gas turbines, 15:36890 (BA;US)
Dynamic tests of wind turbine metallic blades (Lamboley process), 15:36875 (R;FR;In French)

TURBULENCE
Spectral transport model for turbulence, 15:37739 (R;US)

TVA
See TENNESSEE VALLEY AUTHORITY

TWO-NUCLEON TRANSFER REACTIONS
Fission fragment angular distributions following transfer reactions for $^{232}Th + {}^{16}O$, 15:37884 (R;AU)
TWO-PHASE FLOW
Numerical simulation of turbulent gas-particle fluid flow and heat transfer, 15:38120 (RA;US)
TYPE-II SUPERCONDUCTORS
Forces upon vortices in anisotropic superconductors, 15:37982 (J;US)
TYPE-III SUPERCONDUCTORS
See TYPE-II SUPERCONDUCTORS

U

UCLLL
See LAWRENCE LIVERMORE LABORATORY
UJM
See JET MODEL
ULTRACENTRIFUGE ENRICHMENT PLANTS
See CENTRIFUGE ENRICHMENT PLANTS
ULTRACOLD NEUTRONS
General report on UCN facility experiment, 15:37927 (RA;JP;In Japanese)
Some issues in elementary particle physics involving low-energy neutrons and antiprotons focusing on measurement of violated symmetry, 15:37792 (RA;JP;In Japanese)
Superfluidity helium type UCN converters, 15:37928 (RA;JP;In Japanese)
ULTRAFILTRATION
Membrane separation systems—A research and development needs assessment: Executive summary: Volume 1, 15:37147 (R;US)
ULTRASONIC TESTING
Ultrasonic signal processing and B-SCAN imaging for nondestructive testing. Application to under - cladding - cracks, 15:36936 (R;FR;In French)
UNCORRELATED-JET MODEL
See JET MODEL
UNDERGROUND DISPOSAL
Adaptation of magnesian cements to underground storage of nuclear wastes, 15:36779 (R;FR;In French)
Application of the finite-element program NAMMU for a model of a radioactive waste repository site, 15:36765 (R;DE;In German)
UNDERWATER VEHICLES
See SUBMARINES
UNDULATORS
See WIGGLER MAGNETS
UNIFIED GAUGE MODELS
See also STANDARD MODEL
Topics in gauge theories and the unification of elementary particle interactions: Progress report, March 1, 1990–February 28, 1990, 15:37754 (R;US)
UNIPOLAR TRANSISTORS
See FIELD EFFECT TRANSISTORS
UNITED STATES OF AMERICA
See USA
UNIVERSE
Constraints for toroidal cosmology, 15:37702 (J;US)
Eternal annihilations: New constraints on long-lived particles from big-bang nucleosynthesis, 15:37703 (J;US)
UNIVERSITIES
See EDUCATIONAL FACILITIES
UPSILON-9460 MESONS
Heavy flavor resonances and QED radiative corrections, 15:37799 (J;US)
UPSILON-9500 RESONANCES
See UPSILON-9460 MESONS
URANIUM
See also DEPLETED URANIUM
Safeguards training course: Nuclear material safeguards for enrichment plants: Part 3, Uranium enrichment plant: Description, material control and accountability procedures, and safeguards, 15:36811 (R;US)
Uranium storage bed accident hazards evaluation, 15:38107 (RA;US)
URANIUM 235 TARGET
Resonance analysis and evaluation of the ^{235}U neutron induced cross sections, 15:37886 (R;US)
URANIUM 238 REACTIONS
Microscopic study of the ^{238}U-^{238}U system and anomalous pair production, 15:37888 (J;US)
URANIUM 238 TARGET
Excitation and fission decay of ^{238}U using the (^{17}O,$^{17}O'$) reaction, 15:37889 (J;US)
Microscopic study of the ^{238}U-^{238}U system and anomalous pair production, 15:37888 (J;US)
URANIUM ALLOYS
Magnetic excitations in USn_3, 15:37222 (J;US)
URANIUM COMPOUNDS
See also URANIUM OXIDES
Biological characterization of radiation exposure and dose estimates for inhaled uranium milling effluents: Final report, 15:36803 (R;US)
Frequency mixing in de Haas–van Alphen oscillations in heavy-fermion compounds, 15:37220 (J;US)
Shape of the upper-critical-field curves in URu_2Si_2: Evidence for anisotropic pairing, 15:37986 (J;US)
URANIUM HEXAFLUORIDE
Toward more realistic material models for release and dispersion of heavy gases, 15:37587 (R;US)
URANIUM OXIDES
Biological characterization of radiation exposure and dose estimates for inhaled uranium milling effluents: Final report, 15:36803 (R;US)
UREA
Simultaneous NO_x/SO_2 removal by the dry injection of lime-urea hydrate: Final report, 15:36897 (R;US)
US DOE
See also ENERGY INFORMATION ADMINISTRATION
HANFORD RESERVATION
IDAHO NATIONAL ENGINEERING LABORATORY
LASL
LAWRENCE LIVERMORE LABORATORY
NEVADA TEST SITE
ORNL
PORTSMOUTH GASEOUS DIFFUSION PLANT
ROCKY FLATS PLANT
SAVANNAH RIVER PLANT
Annual outlook for US electric power 1990: Projections through 2010, 15:37035 (R;US)
Basic energy sciences: Summary of accomplishments, 15:37022 (R;US)
Compendium of Federal legislation, policies and procedures: Guidance for the administration of DOE grants and cooperative agreements, 15:37029 (R;US)
DOE uses transportable irradiator for demonstration and testing, 15:37662 (J;US)
Department of Energy Strategic Defense Initiative programs: Potential programmatic and facility impacts due to a prospective defense and space treaty, 15:37554 (R;US)
Energy storage and distribution program summary: Volume 2, Research summaries, Fiscal year 1989, 15:37021 (R;US)
US NRC
Action plans for motor-operated valves and check valves, 15:36974 (R;US)
KWOC [Key-Word-Out-of-Context] Index of US Nuclear Regulatory Commission Regulatory Guide Series, 15:37031 (R;US)
Title list of documents made publicly available, February 1–28, 1990: Volume 12, No. 2, 15:36933 (R;US)
USA
See also FEDERAL REGION IV
FEDERAL REGION X
Constitutional implications of implementing a chemical weapons convention, 15:37559 (R;US)

V

VA CHARACTERISTIC
See ELECTRIC CONDUCTIVITY
VACUUM SYSTEMS
Compact Ignition Tokamak, vacuum vessel, design and development, 15:38141 (RA;US)
Location and repair of air leaks in the ATF vacuum vessel, 15:38140 (RA;US)
Stress analysis of JT-60U tokamak, 15:38228 (RA;US)
The construction of the RFX vacuum vessel, 15:38139 (RA;US)
VALENCE ELECTRONS
See ELECTRONS
VALVES
Action plans for motor-operated valves and check valves, 15:36974 (R;US)
Regulatory analysis for the resolution of generic issue C—8, main steam isolation valve leakage and LCS [leakage control system] failure, 15:36905 (R;US)
VANADIUM
Fabricating vanadium sheet to improve symmetry of drawn parts, 15:37195 (R;US)
VANADIUM ALLOYS
Compendium of material test results on HY-130 and Ti-3Al-2V metals in support of United States Navy programs: Interim report, 15:37197 (R;US)
Deposition and adhesion of PECVD boron coatings on Ti-6Al-4V substrates, 15:37202 (BA;US)
VANADIUM OXIDES
A comparative study of $V_6O_{13.27}$ and V_6O_{13}, 15:37204 (J;US)
Properties of electrolyte and electrode films prepared by rf and dc magnetron sputtering, 15:37247 (BA;US)
VAPORS
Trends in dish-Stirling solar receiver designs, 15:36859 (R;US)
VARISTORS
See SEMICONDUCTOR RESISTORS
VEGETATION
See PLANTS
VENTILATION
Leak rate test of containment personnel lock, 15:36978 (RA;US)
Recommendations for the design, manufacture and construction of ventilation systems in nuclear power plants with pressurized water reactors, 15:37940 (R;DD;In German)
VENTILATION DUCTS
See VENTILATION
VENTILATION SYSTEMS
EXPAC [EXPlosion Analysis Code] user's manual: A computer code for analyzing explosion-induced flow and material transport in nuclear facilities, 15:36802 (R;US)
Filtered containment venting systems for Swiss LWR's - proposed design requirements and principles, 15:36976 (RA;US)
Filtered vented containments, 15:36977 (RA;US)
VERSENE
See EDTA
VERTICAL AXIS TURBINES
Liquid crystals for surface shear stress visualization on wind turbine airfoils, 15:36881 (BA;US)
The Sandia/DOE/USDA 34-meter-diameter vertical axis wind turbine test bed, 15:36880 (BA;US)
VAWT stochastic loads using a 3-D turbulence simulation, 15:36882 (BA;US)
VESSELS (CHEMICAL REACTIONS)
See CHEMICAL REACTORS
VESSELS (PRESSURE)
See PRESSURE VESSELS
VESSELS (REACTOR)
See REACTOR VESSELS
VIBRATION MODES
See OSCILLATION MODES
VIBRATIONS (MECHANICAL)
See MECHANICAL VIBRATIONS
VISCOSITY
Verification of product quality from process control, 15:36776 (R;US)
Viscosity, electrical conductivity, and cesium volatility of ORNL [Oak Ridge National Laboratory] vitrified soils with limestone and sodium additives, 15:36785 (R;US)
VISIBLE RADIATION
A visible plasma, 15:38065 (BA;US)
VOCABULARY (CONTROLLED)
See STANDARDIZED TERMINOLOGY
VOCATIONAL TRAINING
See TRAINING
VOGTLE-1 REACTOR
Loss of vital ac power and the residual heat removal system during mid-loop operations at Vogtle Unit 1 on March 20, 1990, 15:36975 (R;US)
VOLATILE MATTER
Advances in air-stripper technology, 15:37612 (R;US)
VOLCANOES
Smithsonian Institution: Bulletin of the Global Volcanism Network. Monthly report, 15:37689 (R;US)
VOLT-AMPERE CHARACTERISTIC
See ELECTRIC CONDUCTIVITY
VOLTAGE
See ELECTRIC POTENTIAL
VOLTAIC CELLS
See ELECTRIC BATTERIES
VULCANIZATION
Proceedings of the international symposium on radiation vulcanization of natural rubber latex, 15:36817 (R;JP)

W

W CODES
U-values, solar heat gain and thermal performance: Recent studies using the MoWiTT, 15:37134 (BA;US)
WARFARE
See also CONVENTIONAL WARFARE
Historical validation of an attrition model, 15:37546 (R;US)
Recent advances in analytic combat simulation: From modeling to validation and beyond, 15:37545 (R;US)
WASTE BURIAL
See UNDERGROUND DISPOSAL
WASTE FORMS
[Nuclear waste management]: Foreign trip report, October 6, 1988–November 6, 1988, 15:36781 (R;US)
WASTE HEAT
Utilization of off-peak electric power to improve cycle efficiency during peak demand periods, 15:36887 (R;US)
WASTE MANAGEMENT
See also RADIOACTIVE WASTE MANAGEMENT
WASTE TRANSPORTATION
On the implementation of complex many-to-many relations in focus, 15:38321 (R;US)
SKB annual report 1988: Including summaries of technical reports issued during 1988, 15:36790 (R;SE)
Safety and cost evaluation of nuclear waste management, 15:36794 (R;FI;In Finnish)
WASTE TRANSPORTATION
Transporting spent and damaged fuel in the United States: Recent experience and lessons learned related to the evolving transportation policy of the US Department of Energy, 15:36760 (R;US)
WASTE WATER
Operation of a mobile pilot-scale continuous countercurrent ion exchange system for treatment of low-level radioactive wastewaters, 15:36774 (R;US)
WASTEFORMS
See WASTE FORMS
WASTES
See also GASEOUS WASTES
INDUSTRIAL WASTES
RADIOACTIVE WASTES
WASTE HEAT
Proceedings of the 6th national conference on hazardous wastes and hazardous materials, 15:37605 (B;US)

WATER
See also DRINKING WATER
GROUND WATER
WASTE WATER
Annual radiological environmental monitoring report, Watts Bar Nuclear Plant, 1989, 15:37581 (R;US)
Annual radiological environmental operating report, Browns Ferry Nuclear Plant, 1989, 15:37582 (R;US)
Annual radiological environmental operating report, Sequoyah Nuclear Plant, 1989, 15:37583 (R;US)
Bond-selected bimolecular chemistry: $H+HOD(4\nu_{OH})\rightarrow OD+H_2$, 15:37354 (J;US)
Hanford Environmental Dose Reconstruction Project: Monthly report, 15:37579 (R;US)
Onsite environmental report for the Nevada Test Site, January 1988–December 1988, 15:37567 (R;US)
Thermal diffuse x-ray-scattering studies of the water-vapor interface, 15:37748 (J;US)

WATER COOLANT
See WATER

WATER COOLED REACTORS
See also ACPR REACTOR
BWR TYPE REACTORS
ORPHEE REACTOR
PWR TYPE REACTORS
Filtered containment venting systems for Swiss LWR's - proposed design requirements and principles, 15:36976 (RA;US)

WATER DISTRIBUTION
See WATER SUPPLY

WATER MODERATOR
See WATER

WATER RESERVOIRS
Surface water resources issues analysis: Wheeler Reservoir watershed region, 15:37621 (R;US)

WATER RESOURCES
Surface water resources issues analysis: Wheeler Reservoir watershed region, 15:37621 (R;US)

WATER SOLUTIONS
See AQUEOUS SOLUTIONS

WATER SUPPLY
Uncertainty in exposure and health-risk assessment: An integrated approach, 15:37623 (R;US)

WATER TABLES
Cokriging model for estimation of water table elevation, 15:37627 (J;US)

WATERBORNE PARTICLES
See PARTICULATES

WATERSHEDS
Acidic deposition on Walker Branch Watershed, 15:37606 (BA;US)

WAVE PROPAGATION
Large amplitude waves and fields in plasmas, 15:38039 (R;GB)

WEAPONS
See also CHEMICAL WARFARE AGENTS
Selecting appropriate test targets for portal weapons detection, 15:37380 (R;US)

WEATHERIZATION
Measured space-cooling electricity savings from standard energy conservation measures, radiant barriers, and high-efficiency window air conditioners, 15:37118 (R;US)

WECS
See WIND TURBINES

WELDED JOINTS
Engineering critical assessment of girth welds in small diameter pipe: Final report, 15:36750 (R;CA)
Investigation of sulfide-stress cracking at pipe seam welds, 15:36748 (R;US)
The significance of local hard zones on the outside of pipeline girth welds: Final report, 15:36735 (R;GB)

WELDS
See WELDED JOINTS

WELL CASINGS
Cathodic protection evaluation of well casings using wireline techniques, 15:36727 (RA;CA)

WESTERN EUROPE
See also FRANCE
SWITZERLAND
Integration of the natural gas markets in Western Europe, 15:36745 (BA;US)

WET-TYPE COOLING TOWERS
See COOLING TOWERS

WETLANDS
Hydric hammocks: A guide to management, 15:37594 (R;US)
Response of woody swamp seedlings to flooding and increased water temperatures. I. Growth, biomass, and survivorship, 15:37628 (J;US)
Substrate heterogeneity and regeneration of a swamp tree, Nyssa aquatica, 15:37608 (J;US)

WIGGLER MAGNETS
A micro-fabrication compatible wiggler design scalable to submillimeter periods, 15:38282 (BA;US)

WIND
Results of a detailed field measurement program to evaluate micrositing tools, 15:36886 (BA;US)
The wind lumps that bump a rotor, 15:36885 (BA;US)

WIND ENERGY CONVERSION SYSTEMS
See WIND TURBINES

WIND FARMS
See WIND TURBINE ARRAYS

WIND GENERATORS
See WIND TURBINES

WIND LOADS
Pressure measurements on a 5.35 m hawt in CARDC wind tunnel compared to theoretical pressure distributions, 15:36878 (R;SE)

WIND TURBINE ARRAYS
Technical description of AVENU: A comprehensive computer software system for wind farm design, 15:36884 (BA;US)
The HNEI/Kahua wind energy storage test facility, 15:36883 (BA;US)

WIND TURBINES
See also HORIZONTAL AXIS TURBINES
VERTICAL AXIS TURBINES
Dynamic tests of wind turbine metallic blades (Lamboley process), 15:36875 (R;FR;In French)
Results of a detailed field measurement program to evaluate micrositing tools, 15:36886 (BA;US)
Study and development of a mounted complier for wind turbines, 15:36876 (R;FR;In French)
The United States Wind Energy Technology Research Program, 15:36879 (BA;US)
The wind lumps that bump a rotor, 15:36885 (BA;US)
Wind heating feasibility, 15:36877 (R;FR;In French)

WINDOWS
Evaluation of advanced glazing technologies, 15:37133 (BA;US)
U-values, solar heat gain and thermal performance: Recent studies using the MoWiTT, 15:37134 (BA;US)

WIRES
See also SUPERCONDUCTING WIRES
Quantum transport in mesoscopic systems: Annual technical report, September 1989–September 1990, 15:37988 (R;US)

WOOD ALCOHOL
See METHANOL

WORKERS
See PERSONNEL

X

X RADIATION
See also HARD X RADIATION
Activation of oncogenes by radon progeny and x-rays, 15:37665 (R;US)
Workshop on high heat load x-ray optics, 15:37707 (R;US)
X-ray crystal devices for measuring compression and stability of laser fusion targets: Final report, 15:38020 (R;US)

X-2830 RESONANCES
See MESONS

X-RASERS
See X-RAY LASERS
X-RAY DETECTION
X-ray streak camera with 2 ps response, 15:37544 (J;US)
X-RAY DIFFRACTION
Time resolved techniques: An overview, 15:37538 (R;US)
X-RAY LASERS
Holographic interferometry of gas-puff Z-pinches, 15:38075 (BA;US)
Identification of hydrogenlike and heliumlike transitions in the spectrum of laser-produced magnesium plasmas, 15:37414 (J;US)
XENON
A comparative kinetic study of xenon adsorption on a flat Pt(111) and stepped Pt(557) and Pt(112) surfaces, 15:37366 (J;US)
Holographic interferometry of gas-puff Z-pinches, 15:38075 (BA;US)
Prospect of multiphoton induced inner shell excitations for x-ray laser pumping, 15:38296 (BA;US)
XENON 133
Onsite environmental report for the Nevada Test Site, January 1988–December 1988, 15:37567 (R;US)
XENON IONS
Precision spectroscopy of n=3 to n=2 transitions in Li-like and Be-like xenon, 15:37734 (J;US)

Y

Y*RESONANCES
See BARYONS
YANG-MILLS THEORY
Singularity of Green's function and effective action in massive Yang-Mills theories, 15:37820 (J;US)
The β-function in 4-dimensional topological Yang-Mills theory, 15:37810 (R;DK)
YRAST STATES
Conversion coefficients and yrast state spins in ^{180}Os, 15:37875 (R;AU)
YTTERBIUM 164
Deformation effects in the compound nucleus decay using the spin-alignment method, 15:37871 (J;US)
YTTERBIUM 170
Deformation effects in the compound nucleus decay using the spin-alignment method, 15:37871 (J;US)
YTTERBIUM COMPOUNDS
Frequency mixing in de Haas–van Alphen oscillations in heavy-fermion compounds, 15:37220 (J;US)
Magnetic field dependence of the specific heat of heavy-fermion $YbCu_{4.5}$, 15:37288 (R;US)
Pressure dependence of the specific heat of heavy-fermion $YbCu_{4.5}$, 15:37979 (R;US)
YTTRIUM ALUMINIUM GARNETS
See ALUMINIUM OXIDES
YTTRIUM OXIDES
Absorption Spectra
Determination of the valence of Pr, Gd, and Ho in $YBa_2Cu_3O_7$ by x-ray absorption spectroscopy, 15:37221 (J;US)
Atom Transport
Monte Carlo study of tracer and chemical diffusion of oxygen in $YBa_2Cu_3O_{6+2c}$, 15:37273 (J;US)
Bromination
Metallization and superconducting properties of $YBa_2Cu_3O_{6.2}Br_y$, 15:37275 (J;US)
Critical Current
Large, orientation-dependent enhancements of critical currents in $Y_1Ba_2Cu_3O_{7-x}$ epitaxial thin films: Evidence for intrinsic flux pinning?, 15:37228 (R;US)
Neutron-induced microwave loss in ceramic $YBa_2Cu_3O_{7-\delta}$, 15:37259 (J;US)
Rapid thermal processing of $YBa_2Cu_3O_7$ spun wires, 15:37261 (J;US)
Transport critical current density and microstructure in extruded $YBa_2Cu_3O_{7-x}$ wires processed by zone melting, 15:37250 (J;US)
Crystal-Phase Transformations
Numerical investigation of a model for oxygen ordering in $YBa_2Cu_3O_{6+x}$, 15:37265 (J;US)
Deposition
Theoretical model for deposition of superconducting thin films using pulsed laser evaporation technique, 15:37251 (J;US)
Dielectric Properties
Temperature and frequency dependences of the dielectric properties of $YBa_2Cu_3O_{6+x}$ ($x\approx0$), 15:37270 (J;US)
Growth
Y-Ba-Cu-O thin films grown on rigid and flexible polycrystalline yttria-stabilized zirconia by pulsed laser ablation, 15:37249 (J;US)
Heat Treatments
Rapid thermal processing of $YBa_2Cu_3O_7$ spun wires, 15:37261 (J;US)
Some observations of the effects of high pressures and temperatures on the stability of $YBa_2Cu_3O_{7-x}$, 15:37355 (J;US)
Ionic Conductivity
Intrinsic fast oxygen ionic conductivity in the $Gd_2(Zr_xTi_{1-x})_2O_7$ and $Y_2(Zr_xTi_{1-x})_2O_7$ pyrochlore systems, 15:37246 (BA;US)
Magnetic Flux
Increase in the flux-pinning energy of $YBa_2Cu_3O_{7-\delta}$ by shock compaction, 15:37255 (J;US)
Mechanical Properties
Increase in the flux-pinning energy of $YBa_2Cu_3O_{7-\delta}$ by shock compaction, 15:37255 (J;US)
Microstructure
Transport critical current density and microstructure in extruded $YBa_2Cu_3O_{7-x}$ wires processed by zone melting, 15:37250 (J;US)
Phase Diagrams
Phase diagram and low-temperature behavior of oxygen ordering in $YBa_2Cu_3O_z$ using *ab initio* interactions, 15:37263 (J;US)
Physical Radiation Effects
Neutron-induced microwave loss in ceramic $YBa_2Cu_3O_{7-\delta}$, 15:37259 (J;US)
Raman Spectra
Raman-active phonons of a twin-free $YBa_2Cu_3O_7$ crystal: A complete polarization analysis, 15:37266 (J;US)
Spin-Lattice Relaxation
Spin and charge excitations in $YBa_2Cu_3O_7$: Constraints from spin-relaxation rates in the normal state, 15:37274 (J;US)
Superconductivity
Metallization and superconducting properties of $YBa_2Cu_3O_{6.2}Br_y$, 15:37275 (J;US)
Superconducting thin-film multiturn coils of $YBa_2Cu_3O_{7-x}$, 15:37420 (J;US)
Superconductivity and oxygen ordering in $(Ca,Ba,La)Cu_3O_{7-\delta}$, 15:37276 (J;US)
Transition Temperature
Rapid thermal processing of $YBa_2Cu_3O_7$ spun wires, 15:37261 (J;US)
Superconductivity under high pressure of $YBa_2(Cu_{1-xMx})_3O_{7-\delta}$ (M=Fe, Co, Al, Cr, Ni, and Zn), 15:37264 (J;US)
YUCCA MOUNTAIN
Stratigraphic correlation and petrography of the bedded tuffs, Yucca Mountain, Nye County, Nevada, 15:37690 (R;US)

Z

Z NEUTRAL BOSONS
Electromagnetic radiative corrections at LEP-SLC energies for experimentalists, 15:37775 (R;FR)
Study of the muonic channel of $e^+e^- \rightarrow \mu^+\mu^-(\gamma)$ for the DELPHI experiment: radiative corrections and performance of trigger and reconstruction systems, 15:37776 (R;FR;In French)
The measurability, by means of the DELPHI detector, of the Z^0 mass and width from the $e^+e^- \rightarrow \mu^+\mu^-\gamma_1...\gamma_n$ (muons) reaction, 15:37774 (R;FR;In French)

Z PINCH DEVICES (LINEAR)
See LINEAR Z PINCH DEVICES
ZINC OXIDES
Laser ultrasonic measurements on ceramic materials with rough surfaces, 15:37232 (R;US)
Real-time monitoring of ceramic sintering with laser ultrasonics, 15:37231 (R;US)
ZIRCALOY
Zircaloy cladding performance under spent fuel disposal conditions: Progress report, May 1–October 31, 1989, 15:36766 (R;US)
ZIRCONIUM 90 TARGET
Models and theory for precompound angular distributions, 15:37909 (R;US)
Preequilibrium (*p,n*) reaction as a probe for the effective nucleon-nucleon interaction in multistep direct processes, 15:37863 (J;US)
ZIRCONIUM ALLOYS
Formation of cubic Ll_2 phases from Al_3Ti and Al_3Zr by transition metal substitutions for Al, 15:37180 (R;US)
ZIRCONIUM OXIDES
Activation evaluation of fusion solid breeder materials, 15:38171 (RA;US)
Coarsening kinetics of the tetragonal phase in a manganesia-partially-stabilized zirconia, 15:37257 (J;US)
Intrinsic fast oxygen ionic conductivity in the $Gd_2(Zr_xTi_{1-x})_2O_7$ and $Y_2(Zr_xTi_{1-x})_2O_7$ pyrochlore systems, 15:37246 (BA;US)
Wear mechanisms of amorphous carbon and zirconia coatings on rigid disk magnetic recording media, 15:37241 (R;US)
ZT-40 DEVICES
Confinement dynamics in the ZT-40M RFP, 15:38063 (BA;US)
ZT-P DEVICES
Experimental studies of equilibrium in the toroidal Extrap T1 experiment, 15:38041 (R;SE)
Ion heat conduction losses in Extrap, 15:38044 (R;SE)

Contract Number Index

Numbers assigned to DOE contracts announced in documents in this publication are listed. Contract numbers are sorted alphanumerically and list the primary corporate author of the document cited, the citation number, and the report number or other document identification.

Contract No.	Abstract No.	Report No.
AA03-76SF00034		
	15:37783	Published article
AC01-85PE77026	**Energetics, Inc., Columbia, MD (USA)**	
	15:37149	DOE/PE/77026–T1
AC01-88DP50066	**Science Applications International Corp., McLean, VA (USA)**	
	15:37160	DOE/DP/50066–T5
	15:37161	DOE/DP/50066–T8
	15:37554	DOE/DP/50066–T6
	15:37559	DOE/DP/50066–T7
AC01-88EH79072	**Factory Mutual Research Corp., Norwood, MA (USA)**	
	15:36799	DOE/EH/79072–T4
AC01-88ER30133	**USDOE Office of Energy Research, Washington, DC (USA). Office of Program Analysis**	
	15:37147	DOE/ER/30133–H1-Vol.1
	15:37148	DOE/ER/30133–H1-Vol.2
AC02-76CH00016	**Brookhaven National Lab., Upton, NY (USA)**	
	15:36723	BNL–44684
	15:36766	BNL–52235
	15:36809	BNL–52219
	15:36869	BNL–44708
	15:36914	BNL-NUREG–44501
	15:37280	BNL–42887
	15:37392	BNL-NUREG–43991
	15:37430	BNL–44618
	15:37510	BNL–44687
	15:37537	BNL–44686
	15:37663	BNL–44646
	15:37824	BNL–44710
	15:37825	BNL–44713
	15:37260	Published article
	15:37264	Published article
	15:37268	Published article
	15:37312	Published article
	15:37314	Published article
	15:37322	Published article
	15:37338	Published article
	15:37417	Published article
	15:37724	Published article
	15:37732	Published article
	15:37735	Published article
	15:37748	Published article
	15:37785	Published article
	15:37818	Published article
	15:37861	Published article
	15:37867	Published article
	15:37915	Published article
AC02-76CH03000	**Fermi National Accelerator Lab., Batavia, IL (USA)**	
	15:37404	FNAL-TM–1657
	15:37405	FNAL-TM–1660
	15:37455	FNAL/C–90/101
	15:37456	FNAL/C–90/102
	15:37519	FNAL/C–90/46
	15:37520	FNAL/C–90/110
	15:37755	FNAL/C–90/85-E
	15:37756	FNAL/C–90/86-E
	15:37757	FNAL/C–90/91-E
	15:37758	FNAL/C–90/93-E
	15:37759	FNAL/C–90/100-E
	15:37760	FNAL/C–90/118-E
AC02-76CH03073	**Oak Ridge National Lab., TN (USA)**	
	15:38109	CONF-891007–Vol.2
	15:38125	CONF-891007–Vol.2
	15:38136	CONF-891007–Vol.2
	15:38138	CONF-891007–Vol.2
	15:38147	CONF-891007–Vol.2
	15:38159	CONF-891007–Vol.2
	15:38176	CONF-891007–Vol.2
	15:38177	CONF-891007–Vol.2
	15:38182	CONF-891007–Vol.2
	15:38186	CONF-891007–Vol.2
	15:38189	CONF-891007–Vol.2
	15:38191	CONF-891007–Vol.2
	15:38201	CONF-891007–Vol.2
	15:38209	CONF-891007–Vol.2
	15:38214	CONF-891007–Vol.2
	15:38218	CONF-891007–Vol.2
	15:38241	CONF-891007–Vol.2
	15:38246	CONF-891007–Vol.2
	15:38247	CONF-891007–Vol.2
	15:38249	CONF-891007–Vol.2
	15:38250	CONF-891007–Vol.2
	15:38254	CONF-891007–Vol.2
	Princeton Univ., NJ (USA). Plasma Physics Lab.	
	15:38032	PPPL–2697
	15:38033	PPPL–2699
	15:38034	PPPL–2700
	15:38035	PPPL–2703
	15:38036	PPPL–2707
	15:37970	Published article
	15:38089	Published article
AC02-76ER01112		
	15:37798	CONF-8905213–
	15:37799	CONF-8905213–
AC02-76ER01198		
	15:37274	Published article
AC02-76ER02220		
	15:37702	Published article
	15:37744	Published article
	15:37962	Published article
AC02-76ER03071		
	15:37819	Published article
AC02-76ER03074	**Brookhaven National Lab., Upton, NY (USA)**	
	15:37825	BNL–44713
AC02-76ER03075		
	15:37700	Published article
	15:37785	Published article
	15:37817	Published article
AC02-76ER03230	**Brandeis Univ., Waltham, MA (USA). Dept. of Physics**	
	15:37753	DOE/ER/03230–T9

Contract No.	Abstract No.	Report No.
AC02-76ER13065		
	15:37815	Published article
	15:38000	Published article
AC02-79ET10815	**Tennessee Univ., Tullahoma, TN (USA). Space Inst.**	
	15:37040	DOE/ET/10815–149
	15:37041	DOE/ET/10815–150
AC02-80ET15601	**MSE, Inc., Butte, MT (USA)**	
	15:37039	CONF-9006105–8
AC02-83CE40626	**Maine Univ., Orono, ME (USA)**	
	15:37146	DOE/CE/40626–T5
AC02-83CH10093	**Solar Energy Research Inst., Golden, CO (USA)**	
	15:36827	SERI/PR–215-3617
	15:36828	SERI/TP–254-3611
	15:36829	SERI/TR–215-3482
	15:37021	DOE/CH/10093–73
AC02-84ER40125		
	15:37972	Published article
AC02-85CE76254	**Rochester Univ., NY (USA)**	
	15:37685	DOE/CE/76254–9
AC02-86ER40253		
	15:37797	CONF-8905213–
	15:37995	Published article
AC02-86ER40284		
	15:37800	CONF-8905213–
AC02-89ER40486	**Lawrence Berkeley Lab., CA (USA). SSC Central Design Group**	
	15:37535	SSC–229
AC03-76SF00012		
	15:37654	Published article
	15:37673	Published article
AC03-76SF00098	**Argonne National Lab., IL (USA)**	
	15:37102	CONF-890845–
	Oak Ridge National Lab., TN (USA)	
	15:38149	CONF-891007–Vol.2
	Stanford Linear Accelerator Center, Menlo Park, CA (USA)	
	15:37453	DOE/SF/00515–T89
	15:37505	DOE/SF/00515–T92
	Lawrence Berkeley Lab., CA (USA)	
	15:36900	LBL–28869
	15:37120	LBL–27440
	15:37288	LBL–28747
	15:37979	LBL–28749
	15:37980	LBL–28750
	Lawrence Livermore National Lab., CA (USA)	
	15:37501	UCRL–100089
	15:37882	UCRL–103001
	15:37211	Published article
	15:37212	Published article
	15:37259	Published article
	15:37263	Published article
	15:37272	Published article
	15:37311	Published article
	15:37323	Published article
	15:37420	Published article
	15:37421	Published article
	15:37422	Published article
	15:37423	Published article
	15:37780	Published article
	15:37784	Published article
	15:37799	CONF-8905213–
	15:37883	Published article
	15:37887	Published article
	15:37999	Published article
	15:38002	Published article
AC03-76SF00515	**Stanford Linear Accelerator Center, Menlo Park, CA (USA)**	
	15:37453	DOE/SF/00515–T89
	15:37454	DOE/SF/00515–T95
	15:37459	SLAC-CN–376
	15:37484	DOE/SF/00515–T90
	15:37485	DOE/SF/00515–T91
	15:37505	DOE/SF/00515–T92
	15:37506	DOE/SF/00515–T93
	15:37507	DOE/SF/00515–T94
	15:37533	SLAC-PUB–5212
	15:37812	SLAC-PUB–5185
	15:38333	SLAC-PUB–5241
	15:38334	SLAC-PUB–5242
	Stanford Research Inst., Menlo Park, CA (USA)	
	15:37534	SLAC-PUB–5224
	Lawrence Livermore National Lab., CA (USA)	
	15:37501	UCRL–100089
	Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility	
	15:37440	DOE/ER/40150–126
	15:37471	DOE/ER/40150–126
	15:37478	DOE/ER/40150–126
	15:37483	DOE/ER/40150–126
	15:37799	CONF-8905213–
	15:37983	Published article
AC03-89ER51114	**Oak Ridge National Lab., TN (USA)**	
	15:38010	CONF-891007–Vol.2
	15:38118	CONF-891007–Vol.2
	15:38133	CONF-891007–Vol.2
	15:38142	CONF-891007–Vol.2
	15:38211	CONF-891007–Vol.2
	15:38227	CONF-891007–Vol.2
	15:38229	CONF-891007–Vol.2
	15:38243	CONF-891007–Vol.2
AC03-89ER52153	**Oak Ridge National Lab., TN (USA)**	
	15:38154	CONF-891007–Vol.2
	15:38171	CONF-891007–Vol.2
AC04-76DP00613	**Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.**	
	15:38319	KCP–613-4278
AC04-76DP00789	**Oak Ridge National Lab., TN (USA)**	
	15:38148	CONF-891007–Vol.2
	Sandia National Labs., Albuquerque, NM (USA)	
	15:36702	SAND–89-7088
	15:36720	SAND–89-1227C
	15:36754	SAND–89-1895C
	15:36763	SAND–90-1379C
	15:36788	SAND–89-0371
	15:36807	SAND–90-7025C
	15:36814	SAND–90-0806
	15:36835	SAND–90-1258C
	15:36836	SAND–90-1259C
	15:36837	SAND–90-1260C
	15:36844	SAND–90-1201C
	15:36846	SAND–89-1553C
	15:36847	SAND–90-0268C
	15:36856	SAND–89-3116C
	15:36859	SAND–90-1236C
	15:36871	SAND–90-0749C
	15:36949	SAND–90-0383C
	15:36987	SAND–89-3029C
	15:37002	SAND–90-1139C
	15:37017	SAND–89-1380C
	15:37196	SAND–89-2857C
	15:37238	SAND–89-2802C
	15:37239	SAND–89-2860C
	15:37240	SAND–89-3088C
	15:37241	SAND–90-1314C
	15:37242	SAND–90-1670C
	15:37292	SAND–89-2787C

Contract No.	Abstract No.	Report No.
	15:37293	SAND–89-7139
	15:37294	SAND–90-0217
	15:37295	SAND–90-0638C
	15:37296	SAND–90-1560C
	15:37378	SAND–90-0236C
	15:37379	SAND–90-0366
	15:37380	SAND–90-0783C
	15:37381	SAND–90-1272C
	15:37382	SAND–90-1292C
	15:37383	SAND–90-1683C
	15:37388	SAND–89-1301
	15:37399	SAND–90-1063C
	15:37407	SAND–89-2605C
	15:37408	SAND–89-3137C
	15:37409	SAND–90-0048
	15:37410	SAND–90-0061C
	15:37411	SAND–90-0419C
	15:37412	SAND–90-0646C
	15:37445	SAND–89-2723C
	15:37446	SAND–90-0333C
	15:37458	SAND–90-1677C
	15:37536	SAND–90-0661C
	15:37549	ALS/TR–90-006
	15:37557	SAND–89-2928C
	15:37580	SAND–90-0537C
	15:37953	SAND–90-0632C
	15:38040	SAND–89-2775C
	15:38261	SAND–89-2845C
	15:38262	SAND–89-2866C
	15:38263	SAND–89-2927C
	15:38313	SAND–90-1215C
	15:38332	SAND–90-0795
	15:38345	SAND–89-2782C
	15:38346	SAND–90-0690C
	15:38347	SAND–90-1203C
	15:36789	SAND–89-7149
	15:37499	SAND–90-7003
	Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility	
	15:37482	DOE/ER/40150–126
	15:36849	Published article
	15:37258	Published article
	15:37261	Published article
	15:37266	Published article
	15:37270	Published article
	15:37309	Published article
	15:37315	Published article
	15:37318	Published article
	15:37319	Published article
	15:37418	Published article
	15:37464	Published article
	15:37730	Published article
	15:37985	Published article
AC04-76DR00789	**Sandia National Labs., Livermore, CA (USA)**	
	15:37197	SAND–90-8217
AC04-87AL43058	**United Technologies Research Center, East Hartford, CT (USA)**	
	15:37371	DOE/AL/43058–T3
AC05-76ER01067		
	15:37872	Published article
AC05-76OR00033	**Oak Ridge National Lab., TN (USA)**	
	15:37225	CONF-900466–61
	15:37226	CONF-900466–62
	15:37205	Published article
AC05-84ER40150	**Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility**	
	15:37433	DOE/ER/40150–126
	15:37469	DOE/ER/40150–126
	15:37476	DOE/ER/40150–126
AC05-84OR21400	**Argonne National Lab., IL (USA)**	
	15:37053	CONF-890845–
	Mechanical Technology, Inc., Latham, NY (USA)	
	15:37143	CONF-900801–12
	Oak Ridge Gaseous Diffusion Plant, TN (USA)	
	15:36811	K/ITP–343/Pt.3
	Oak Ridge National Lab., TN (USA)	
	15:36690	CONF-900546–9
	15:36691	CONF-900546–10
	15:36692	CONF-900546–11
	15:36759	ORNL/TM–11175
	15:36761	ORNL/FTR–3080
	15:36773	CONF-900679–3
	15:36774	CONF-8909338–1
	15:36780	ORNL/FTR–2845
	15:36781	ORNL/FTR–3114
	15:36782	ORNL/TM–11495
	15:36796	CONF-9004218–1
	15:36804	ORNL–6591
	15:36805	ORNL/M–1149
	15:36806	ORNL/TM–11535
	15:36816	CONF-900814–3
	15:36818	ORNL–6574
	15:36833	ORNL/FTR–2968
	15:36901	ORNL/TM–11301
	15:36911	CONF-900814–1
	15:36912	CONF-900814–2
	15:36915	CONF-900804–1
	15:36927	ORNL/FTR–3647
	15:36932	ORNL/FTR–3640
	15:36940	ORNL/FTR–2887
	15:36941	ORNL/TM–11296
	15:36945	CONF-900563–12
	15:36947	CONF-9002100–
	15:36985	ORNL/FTR–2916
	15:36986	ORNL/FTR–3101
	15:37001	ORNL/TM–11511
	15:37009	CONF-891093–2
	15:37013	ORNL–6608/R2
	15:37014	ORNL–6608/R3
	15:37015	ORNL–6608/R4
	15:37016	ORNL/FTR–3074
	15:37024	CONF-900608–32
	15:37026	CONF-900608–30
	15:37027	CONF-9008104–1
	15:37030	DOE/OR/21400–T458
	15:37031	ORNL/NSP–90/3
	15:37033	CONF-900833–1
	15:37037	ORNL/CON–299
	15:37038	ORNL/CON–300
	15:37043	ORNL/M–1137
	15:37116	CONF-900801–13
	15:37117	CONF-900801–14
	15:37118	CONF-900833–2
	15:37121	ORNL/CON–297
	15:37122	ORNL/M–1173
	15:37123	ORNL/TM–11291
	15:37124	ORNL/TM–11425
	15:37139	ORNL–6626
	15:37140	ORNL/M–1188
	15:37145	CONF-9008117–1
	15:37154	DOE/OR/21400–T257
	15:37159	ORNL/TM–11448
	15:37179	CONF-900466–60
	15:37180	CONF-900466–67
	15:37181	CONF-900756–5
	15:37182	CONF-900756–8
	15:37183	CONF-900886–1

Contract No.	Abstract No.	Report No.
	15:37192	ORNL–6601
	15:37193	ORNL/TM–11159
	15:37228	CONF-900806–5
	15:37229	CONF-900837–2
	15:37281	CONF-900466–63
	15:37289	ORNL/FTR–3008
	15:37290	ORNL/FTR–3643
	15:37327	ORNL–6596
	15:37334	ORNL–6606
	15:37335	ORNL/TM–11540
	15:37373	CONF-9008103–1
	15:37375	DOE/OR–884/R2
	15:37393	CONF-8911193–2
	15:37515	CONF-890902–28
	15:37530	ORNL/TM–11557
	15:37538	CONF-900756–7
	15:37539	ORNL/TM–11380
	15:37545	CONF-9006206–1
	15:37547	ORNL/CSD/TM–269
	15:37548	ORNL/TM–11274
	15:37552	ORNL/FTR–2810
	15:37560	ORNL–6615
	15:37561	ORNL–6628
	15:37563	CONF-891292–1
	15:37600	ORNL/TM–11502
	15:37612	CONF-900676–8
	15:37613	CONF-8905327–1
	15:37617	ORNL/M–1175-Vol.1
	15:37618	ORNL/TM–1175-Vol.2
	15:37652	ORNL/FTR–2956
	15:37655	CONF-8907193–1
	15:37670	ORNL/FTR–2851
	15:37671	ORNL/FTR–3628
	15:37674	ORNL/FTR–3129
	15:37675	ORNL/FTR–3157
	15:37676	ORNL/M–1142
	15:37677	ORNL/M–1143
	15:37678	ORNL/TM–11149
	15:37686	ORNL/FTR–2875
	15:37714	ORNL/FTR–2898
	15:37715	ORNL/TM–11202
	15:37716	ORNL/TM–11442
	15:37741	ORNL/FTR–3071
	15:37752	CONF-900331–11
	15:37826	CONF-900135–11
	15:37836	ORNL–6578
	15:37837	ORNL/FTR–2925
	15:37838	ORNL/FTR–3635
	15:37869	CONF-9005221–4
	15:37876	ORNL/FTR–3623
	15:37880	CONF-900450–5
	15:37881	CONF-9004220–1
	15:37885	ORNL/TM–11490
	15:37886	ORNL/TM–11547
	15:37899	ORNL/FTR–3000
	15:37931	ORNL/FTR–3057
	15:37932	ORNL/TM–11532
	15:37941	CONF-900877–1
	15:37942	CONF-8909210–
	15:37943	CONF-9006216–1
	15:37950	ORNL/FTR–3147
	15:37976	CONF-900817–1
	15:37987	CONF-900466–64
	15:38016	CONF-900264–7
	15:38018	CONF-9007113–1
	15:38019	CONF-9007113–2
	15:38031	ORNL/FTR–3624
	15:38255	CONF-8810231–11
	15:38316	CONF-9005227–1
	15:38321	ORNL–6572
	15:38322	ORNL/FTR–2923
	15:38323	ORNL/FTR–2981
	15:38324	ORNL/FTR–2998
	15:38325	ORNL/FTR–3038
	15:38326	ORNL/FTR–3039
	15:38327	ORNL/FTR–3103
	15:38328	ORNL/FTR–3162
	15:38329	ORNL/M–1121
	15:38330	ORNL/TM–11477
	15:38331	ORNL/TM–11518
	15:36762	ORNL/Sub–89-SD841/1
	15:37000	ORNL/Sub–86-7685/2
	15:37225	CONF-900466–61
	15:37226	CONF-900466–62
	15:37237	ORNL/Sub–84-00214/1
	Lawrence Livermore National Lab., CA (USA)	
	15:36801	DOE/NCT–05
	Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering	
	15:36907	NUREG/CR–4816
	Oak Ridge National Lab., TN (USA). Carbon Dioxide Information Analysis Center	
	15:37571	ORNL/CDIAC–32
	Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research	
	15:36939	NUREG/CR–5439
	15:36944	NUREG/CR–5480
	15:36721	CONF-8904127–
	15:37249	Published article
	15:37251	Published article
	15:37252	Published article
	15:37262	Published article
	15:37355	Published article
	15:37627	Published article
	15:37656	Published article
	15:37657	Published article
	15:37855	Published article
	15:37864	Published article
	15:37865	Published article
	15:37877	Published article
	15:37889	Published article
	15:37933	Published article
	15:37994	Published article
AC05-84OS21400	**Oak Ridge Y-12 Plant, TN (USA)**	
	15:38007	Y/DK–669
AC05-84OT21400	**Oak Ridge Gaseous Diffusion Plant, TN (USA)**	
	15:36812	K/ITP–343/Pt.4
	15:37286	K/ETO–29
	15:37546	K/DSRD–115
AC05-85ER40216	**Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility**	
	15:37439	DOE/ER/40150–126
AC06-76RL01830	**Pacific Northwest Lab., Richland, WA (USA)**	
	15:36729	PNL–7338
	15:36784	PNL–6779
	15:36785	PNL–7331
	15:36786	PNL–7344
	15:36787	PNL–7355
	15:36815	BNWL-CC–2245
	15:37008	PNL–7337
	15:37126	PNL–6109
	15:37127	PNL–6429
	15:37128	PNL–6441
	15:37579	PNL–6450-31-HEDR
	15:37601	PNL–7379
	15:37687	PNL–7370
	15:36848	Published article

Contract No.	Abstract No.	Report No.
AC06-83ER40128		
	15:37419	Published article
AC06-87RL10930	Westinghouse Hanford Co., Richland, WA (USA)	
	15:36928	WHC-SA-0813
	15:36989	WHC-SA-0814
	15:37624	WHC-EP-0145-2
AC07-76ID01570	Oak Ridge National Lab., TN (USA)	
	15:38168	CONF-891007--Vol.2
	15:38247	CONF-891007--Vol.2
	15:38248	CONF-891007--Vol.2
	Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office	
	15:37614	DOE/ID-10274
	EG and G Idaho, Inc., Idaho Falls, ID (USA)	
	15:36700	MISC-90050
	15:36701	MISC-90084
	15:36760	EGG-M-89378
	15:36778	EGG-M-89465
	15:36866	EGG-M-90073
	15:36868	EGG-M-90156
	15:36925	EGG-M-89264
	15:36950	EGG-NE-8940
	15:36964	DOE/ID-10259
	15:36965	DOE/ID-10271
	15:36967	EGG-EAST-8508
	15:36968	EGG-M-89161
	15:36969	EGG-M-89199
	15:36970	EGG-M-90152
	15:36971	EGG-M-90165
	15:36983	OECD/LOFT-T-3907
	15:36984	OECD/LOFT-T-3908
	15:37150	EGG-M-90130
	15:37151	EGG-M-90133
	15:37157	DOE/ID-10262
	15:37231	EGG-M-89513
	15:37232	EGG-M-89514
	15:37233	EGG-M-90175
	15:37283	EGG-M-90228
	15:37284	EGG-MS-8933
	15:37332	EGG-M-90237
	15:37394	EGG-M-89196
	15:37518	EGG-M-89502
	15:37666	EGG-BNCT-8777-Vol.4-No.2
	15:37667	EGG-ESQ-8808
	15:38257	EGG-FSP-8255
	15:38258	EGG-M-89521
	15:36904	DOE/ID-10278
	Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research	
	15:36980	NUREG/CR-5111
	15:37362	Published article
	15:37879	Published article
AC07-81NE44139	West Valley Nuclear Services Co., Inc., West Valley, NY (USA)	
	15:36775	DOE/NE/44139-58
	15:36776	DOE/NE/44139-60
AC07-88ID12735	MSE, Inc., Butte, MT (USA)	
	15:37039	CONF-9006105-8
AC07-88ID12754	Boeing Aerospace Co., Kent, WA (USA)	
	15:36929	DOE/ID/12754-T1
	15:36930	DOE/ID/12754-T2
	15:36931	DOE/ID/12754-T3
AC07-88SF17712	California Univ., San Diego, La Jolla, CA (USA). Dept. of Chemistry	
	15:36874	DOE/SF/17712-T1
AC08-84NV10327	Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA). Health Physics Dept.	
	15:37567	DOE/NV/10630-8
AC08-85NV10384	Nevada Univ., Reno, NV (USA). Water Resources Center	
	15:37615	DOE/NV/10384-33
	Nevada Univ., Las Vegas, NV (USA). Water Resources Center	
	15:37596	DOE/NV/10384-23-Rev.
AC08-88NV10617	EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations	
	15:37402	EGG-10617-5059
	15:37568	EGG-10617-7002
	EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations	
	15:37517	EGG-10617-2064
AC08-89NV10630	Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)	
	15:38317	CONF-9008101-2
	Reynolds Electrical and Engineering Co., Inc., Mercury, NV (USA)	
	15:37595	CONF-9006200-1
	Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA). Health Physics Dept.	
	15:37567	DOE/NV/10630-8
AC12-76SN00052	Knolls Atomic Power Lab., Schenectady, NY (USA)	
	15:37236	KAPL-4715
AC21-84MC21335	Combustion Power Co., Inc., Menlo Park, CA (USA)	
	15:36889	DOE/MC/21335-2823-Vol.1
AC21-86MC21023	Foster Wheeler Development Corp., Livingston, NJ (USA)	
	15:36888	DOE/MC/21023-2825-Vol.1
AC21-86MC23266	Illinois Inst. of Tech., Chicago, IL (USA). Dept. of Chemical Engineering	
	15:37044	DOE/MC/23266-2841
AC21-87MC23283	Institute of Gas Technology, Chicago, IL (USA)	
	15:36693	DOE/MC/23283-2802
AC22-84PC72007	AMAX Research and Development Center, Golden, CO (USA)	
	15:36689	DOE/PC/72007-T14
AC22-86PC91021	Florida State Univ., Tallahassee, FL (USA). Dept. of Physics	
	15:36899	DOE/PC/91021-T9
AC22-86PC91025	Energy and Environmental Research Corp., Irvine, CA (USA)	
	15:36708	DOE/PC/91025-T2
AC22-88PC88852	United Engineers and Constructors, Inc., Denver, CO (USA). Stearns-Roger Div.	
	15:36896	DOE/PC/88852-T2
AC22-88PC88860	Fossil Energy Research Corp., Laguna Hills, CA (USA)	
	15:36897	DOE/PC/88860-T1
AC22-88PC88874	Acurex Corp., Research Triangle Park, NC (USA). Environmental Systems Div.	
	15:36898	DOE/PC/88874-T8
AC22-88PC88949	Westinghouse Electric Corp., Pittsburgh, PA (USA). Science and Technology Center	
	15:36711	DOE/PC/88949-T6
AC22-89PC89867	Bechtel Group, Inc., San Francisco, CA (USA)	
	15:36697	DOE/PC/89867-T1

Contract No.	Abstract No.	Report No.
AC34-90DP62349	Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant	
	15:37195	RFP–4072
AI01-78EV10053	Oregon State Univ., Corvallis, OR (USA)	
	15:37566	DOE/EV/10053–T1
AI05-88OR21749	National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center	
	15:37230	DOE/NASA/21749–1
AI08-78ET44802	Geological Survey, Denver, CO (USA)	
	15:37690	USGS-OFR–89-3
	Geological Survey, Reston, VA (USA)	
	15:36771	CONF-890928–25
AM03-76SF00010		
	15:37801	CONF-8905213–
AM03-76SF00326		
	15:37317	Published article
AS03-87DP10697	Polytechnic Inst. of New York, Brooklyn, NY (USA). Dept. of Physics	
	15:38020	DOE/DP/10697–T1
AS03-88DP10779	California Univ., Davis, CA (USA)	
	15:38256	DOE/DP/10779–T1
AS05-76ER03956		
	15:37795	CONF-8905213–
AS05-76ER04449		
	15:37786	Published article
AS05-80ER10742		
	15:37260	Published article
AS06-88ER40423		
	15:37802	Published article
	15:37821	Published article
AS08-86DP10554		
	15:37414	Published article
AS09-80ER10678		
	15:37672	Published article
FC01-84CE76246	Midwest Research Inst., Kansas City, MO (USA)	
	15:37683	DOE/CE/76246–T14
	15:37684	DOE/CE/76246–T16
FC03-85DP40200		
	15:38304	Published article
	15:38306	Published article
FC05-85ER25000		
	15:37265	Published article
FC07-84ID12481	Ott Engineering, Inc., Bellevue, WA (USA)	
	15:36826	DOE/ID/12481–2
FC07-85NV10425	Louisiana State Univ., Baton Rouge, LA (USA). School of Geoscience	
	15:36867	DOE/NV/10425–T1
FC21-86MC11076		
	15:36756	CONF-8904125–
FC22-83FE60149	National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)	
	15:36726	NIPER–476
FG02-84ER13295	Pennsylvania State Univ., University Park, PA (USA). Dept. of Chemistry	
	15:37340	DOE/ER/13295–4
FG02-84ER45127		
	15:37965	Published article
FG02-84ER45153		
	15:37316	Published article
FG02-84ER52111	Oak Ridge National Lab., TN (USA)	
	15:38212	CONF-891007–Vol.2
FG02-85CE40772	Purdue Univ., Lafayette, IN (USA). Dept. of Agricultural Engineering	
	15:36821	CONF-8808305–1
	15:37144	CONF-8809312–2
FG02-85ER13359	Yale Univ., New Haven, CT (USA). Dept. of Cellular and Molecular Physiology	
	15:37629	DOE/ER/13359–4
FG02-85ER13405		
	15:37541	Published article
FG02-85ER40233	Northeastern Univ., Boston, MA (USA)	
	15:37754	DOE/ER/40233–5
FG02-85ER45190		
	15:37722	Published article
FG02-85ER45200		
	15:37336	Published article
FG02-85ER45214	Pennsylvania State Univ., University Park, PA (USA). Materials Research Lab.	
	15:37184	DOE/ER/45214–5
FG02-85ER53194	Dartmouth Coll., Hanover, NH (USA)	
	15:38021	DOE/ER/53194–3
FG02-85ER53198	Wisconsin Univ., Madison, WI (USA)	
	15:38022	DOE/ER/53198–146
FG02-86ER13580	Lehigh Univ., Bethlehem, PA (USA)	
	15:37341	DOE/ER/13580–3
FG02-86ER53223	New York Univ., NY (USA). Magneto-Fluid Dynamics Div.	
	15:38023	DOE/ER/53223–130
FG02-86ER60422	Atmospheric and Environmental Research, Inc., Cambridge, MA (USA)	
	15:37565	DOE/ER–0459T
FG02-86ER60492	Clarkson Univ., Potsdam, NY (USA). Dept. of Biology	
	15:37635	DOE/ER/60492–5
FG02-87ER13648	State Univ. of New York, Stony Brook, NY (USA). Dept. of Mechanical Engineering	
	15:37282	DOE/ER/13648–7
FG02-87ER13713	Missouri Univ., Columbia, MO (USA). Dept. of Biochemistry	
	15:36819	DOE/ER/13713–4
FG02-87ER13731	Ohio State Univ. Research Foundation, Columbus, OH (USA). Dept. of Microbiology	
	15:37630	DOE/ER/13731–3
FG02-87ER13749		
	15:37963	Published article
FG02-87ER13776		
	15:37328	Published article
	15:37329	Published article
FG02-87ER40342		
	15:37848	Published article
FG02-87ER45326	Ohio State Univ. Research Foundation, Columbus, OH (USA). Dept. of Physics	
	15:37977	DOE/ER/45326–3
FG02-87ER45333		
	15:37220	Published article
FG02-88ER13827		
	15:37352	Published article
	15:37363	Published article
FG02-88ER13847		
	15:37966	Published article
FG02-88ER13889	Delaware Univ., Newark, DE (USA). Dept. of Physics and Astronomy	
	15:37709	DOE/ER/13889–2
FG02-88ER25053		
	15:37743	Published article
FG02-88ER40388	State Univ. of New York, Stony Brook, NY (USA). Dept. of Physics	
	15:37893	DOE/ER/40388–50
	15:37820	Published article
	15:37913	Published article
FG02-88ER40406		
	15:37865	Published article
	15:37871	Published article
FG02-88ER40425		
	15:37912	Published article
FG02-88ER45355	Yale Univ., New Haven, CT (USA). Dept. of Mechanical Engineering	
	15:37185	DOE/ER/45355–2
FG02-88ER45362		
	15:37269	Published article

Contract No.	Abstract No.	Report No.
FG02-88ER60623		Rochester Univ., NY (USA). Dept. of Biophysics
	15:37636	DOE/ER/60623–T2
FG02-88ER60648		
	15:37337	Published article
FG02-89CE90029		Clarkson Univ., Potsdam, NY (USA). Fluid Mechanics, Heat and Mass Transfer Lab.
	15:37374	DOE/CE/90029–2
FG02-89ER14017		
	15:37750	Published article
FG02-89ER40506		
	15:37662	Published article
FG02-89ER60763		Washington Univ., St. Louis, MO (USA). School of Medicine
	15:37643	DOE/ER/60763–1
FG02-89ER60872		Ohio State Univ., Columbus, OH (USA). Dept. of Mechanical Engineering
	15:37644	DOE/ER/60872–1
FG02-89ER60903		Sloan-Kettering Inst. for Cancer Reserch, New York, NY (USA). Dept. of Medical Physics
	15:37665	DOE/ER/60903–1
FG03-84ER40168		
	15:37996	Published article
FG03-85ER13328		Stanford Univ., CA (USA)
	15:37386	DOE/ER/13328–T1
FG03-85ER13408		California Univ., Riverside, CA (USA). Inst. of Geophysics and Planetary Physics
	15:36873	DOE/ER/13408–1
FG03-85ER45197		
	15:38006	Published article
FG03-86ER45230		
	15:37276	Published article
FG03-86ER52123		Oak Ridge National Lab., TN (USA)
	15:38121	CONF-891007–Vol.2
FG03-86ER53225		
	15:38089	Published article
FG03-86ER53228		General Atomics, San Diego, CA (USA)
	15:38259	GA-A–19294
FG03-86ER53232		
	15:38090	Published article
FG03-86ER60391		
	15:37313	Published article
FG03-87ER13752		
	15:37422	Published article
FG03-87ER60504		
	15:37735	Published article
FG03-88ER45378		California Univ., Los Angeles, CA (USA)
	15:37988	DOE/ER/45378–2
	15:37746	Published article
FG03-88SF17538		American Inst. of Architects, Washington, DC (USA)
	15:37119	DOE/SF/17538–T6
FG03-89ER45395		
	15:37969	Published article
FG03-89ER52154		Oak Ridge National Lab., TN (USA)
	15:38170	CONF-891007–Vol.2
FG04-89ER60899		RhoMed, Inc., Albuquerque, NM (USA)
	15:37646	DOE/ER/60899–2
	15:37647	DOE/ER/60899–3
FG05-80ET53088		
	15:38001	Published article
	15:38091	Published article
FG05-84ER13273		
	15:37642	Published article
FG05-84ER40147		
	15:37698	CONF-8911161–
FG05-84ER75151		Michigan State Univ., East Lansing, MI (USA)
	15:37331	DOE/ER/75151–T1
FG05-86ER13482		
	15:37745	Published article
	15:37968	Published article
FG05-86ER40252		
	15:37823	Published article
FG05-86ER40256		EG and G Idaho, Inc., Idaho Falls, ID (USA)
	15:37518	EGG-M–89502
FG05-86ER40272		
	15:37781	Published article
FG05-86ER45259		
	15:37164	Published article
FG05-86ER45268		
	15:37223	Published article
FG05-86ER60473		
	15:38003	Published article
FG05-87ER13794		Rutgers–the State Univ., New Brunswick, NJ (USA). Dept. of Biochemistry and Microbiology
	15:37631	DOE/ER/13794–1
	15:37632	DOE/ER/13794–2
	15:37633	DOE/ER/13794–3
FG05-87ER40322		
	15:37803	Published article
FG05-87ER40374		
	15:38004	Published article
FG05-88ER13859		Tennessee Univ., Knoxville, TN (USA). Dept. of Chemistry
	15:37330	DOE/ER/13859–6
FG05-88ER40407		EG and G Idaho, Inc., Idaho Falls, ID (USA)
	15:37518	EGG-M–89502
FG05-88ER40435		
	15:37910	Published article
FG05-88ER45349		
	15:37964	Published article
FG05-88ER53267		Oak Ridge National Lab., TN (USA)
	15:38235	CONF-891007–Vol.2
FG05-88ER53278		Old Dominion Univ., Norfolk, VA (USA)
	15:38017	CONF-900557–10
FG05-89ER13995		Kentucky Univ., Lexington, KY (USA). Dept. of Microbiology and Immunology
	15:37634	DOE/ER/13995–T1
FG05-89ER53301		Maryland Univ., College Park, MD (USA). Lab. for Plasma Research
	15:38024	DOE/ER/53301–1
FG05-89ER60894		Duke Univ. Medical Center, Durham, NC (USA). Dept. of Radiology
	15:37645	DOE/ER/60894–1
FG06-85ER40224		
	15:37802	Published article
FG09-84ER60255		South Carolina Univ., Columbia, SC (USA). Dept. of Biological Sciences
	15:37658	DOE/ER/60255–6
FG22-85PC80538		Fisk Univ., Nashville, TN (USA). Dept. of Biology
	15:36694	DOE/PC/80538–T1
FG22-86PC90507		California Univ., Berkeley, CA (USA). Coll. of Engineering
	15:36705	DOE/PC/90507–T13
FG22-87PC79914		Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering
	15:36703	DOE/PC/79914–T11
FG22-88PC88922		Georgia Inst. of Tech., Atlanta, GA (USA). School of Chemical Engineering
	15:36695	DOE/PC/88922–6
FG22-88PC88941		West Virginia Univ., Morgantown, WV (USA). Dept. of Mechanical and Aerospace Engineering
	15:36704	DOE/PC/88941–T6

Contract No.	Abstract No.	Report No.
FG22-89BC14204	**Louisiana State Univ., Baton Rouge, LA (USA). Dept. of Petroleum Engineering**	
	15:36724	DOE/BC/14204–6
FG22-89PC89769	**Illinois Inst. of Tech., Chicago, IL (USA). Dept. of Chemical Engineering**	
	15:36713	DOE/PC/89769–T1
FG22-89PC89771	**Louisville Univ., KY (USA). Dept. of Chemical Engineering**	
	15:36696	DOE/PC/89771–1
FG22-89PC89791		
	15:37967	Published article
W-31-109-ENG-38	**Oak Ridge National Lab., TN (USA)**	
	15:38187	CONF-891007–Vol.2
	15:38213	CONF-891007–Vol.2
	Southeastern Universities Research Association, Newport News, VA (USA). Continuous Electron Beam Accelerator Facility	
	15:37472	DOE/ER/40150–126
	15:37250	Published article
	15:37279	Published article
	15:37721	Published article
	15:37749	Published article
	15:37878	Published article
	15:37916	Published article
	15:37986	Published article
W-31109-ENG-38	**Argonne National Lab., Idaho Falls, ID (USA)**	
	15:36917	CONF-900804–6
	15:36919	CONF-900804–8
	Argonne National Lab., IL (USA)	
	15:36706	CONF-900802–1
	15:36707	CONF-900858–1
	15:36709	CONF-900801–5
	15:36717	CONF-900801–4
	15:36764	ANL–90/13
	15:36887	CONF-900801–8
	15:36916	CONF-900804–3
	15:36918	CONF-900804–7
	15:36920	CONF-900804–9
	15:36921	CONF-900804–10
	15:36922	CONF-900804–15
	15:36923	CONF-900804–23
	15:36924	CONF-900804–25
	15:36937	CONF-900804–21
	15:36938	CONF-900804–26
	15:36946	CONF-900804–2
	15:36953	CONF-900804–4
	15:36954	CONF-900804–5
	15:36955	CONF-900804–12
	15:36956	CONF-900804–17
	15:36957	CONF-900804–18
	15:36958	CONF-900804–19
	15:36959	CONF-900804–20
	15:36960	CONF-900804–22
	15:36961	CONF-900804–24
	15:36962	CONF-900804–27
	15:36963	CONF-900804–28
	15:37142	CONF-900801–6
	15:37155	CONF-900801–7
	15:37227	CONF-900801–9
	15:38315	CONF-900874–2
	15:38341	CONF-900875–1
	EG and G Idaho, Inc., Idaho Falls, ID (USA)	
	15:36964	DOE/ID–10259
	Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering	
	15:36906	NUREG/CR–4667-Vol.8
	Argonne National Lab., IL (USA). Advanced Photon Source Div.	
	15:37707	ANL/APS-TM–6
	Argonne National Lab., IL (USA). Energy Systems Div.	
	15:36892	ANL/ESD–7
	15:36893	ANL/ESD/TM–6
	15:36894	ANL/ESD/TM–7-Vol.2
	15:36895	ANL/ESD/TM–8
	15:37156	ANL/ESD–5
	15:37207	Published article
	15:37222	Published article
	15:37260	Published article
	15:37321	Published article
W-7405-ENG-36	**Oak Ridge National Lab., TN (USA)**	
	15:38244	CONF-891007–Vol.2
	Sandia National Labs., Albuquerque, NM (USA)	
	15:37242	SAND–90-1670C
	Los Alamos National Lab., NM (USA)	
	15:36795	LA–11790-MS
	15:36802	LA–11823-M
	15:36860	LA-UR–90-987
	15:36861	LA–11779-MS
	15:36862	LA-UR–90-923
	15:36863	LA-UR–90-932
	15:36864	LA-UR–90-963
	15:36870	LA-UR–90-976
	15:36926	LA-UR–90-1285
	15:37191	LA-UR–90-1068
	15:37287	LA-UR–90-1348
	15:37377	LA-UR–90-1847
	15:37406	LA-UR–90-964
	15:37526	LA-UR–90-1784
	15:37550	LA–11789-MS
	15:37551	LA–11835-MS
	15:37570	LA–11735-MS
	15:37637	LA–11803-PR
	15:37640	LA-UR–90-1568
	15:37739	LA–11821-MS
	15:37740	LA-UR–90-1589
	15:37763	LA–11877-C
	15:37773	LA-UR–90-1783
	15:37978	LA-UR–90-1013
	15:37992	LA-UR–90-1866
	15:38260	LA-UR–90-850
	15:38320	LA-UR–89-3474
	15:38343	LA–11883-C
	15:38344	LA-UR–90-1900
	Lawrence Livermore National Lab., CA (USA)	
	15:37909	UCRL-JC–104221
	15:37396	Published article
W-7405-ENG-48	**Oak Ridge National Lab., TN (USA)**	
	15:38100	CONF-891007–Vol.2
	15:38161	CONF-891007–Vol.2
	15:38166	CONF-891007–Vol.2
	15:38174	CONF-891007–Vol.2
	15:38181	CONF-891007–Vol.2
	15:38220	CONF-891007–Vol.2
	15:38223	CONF-891007–Vol.2
	15:38251	CONF-891007–Vol.2
	Lawrence Livermore National Lab., CA (USA)	
	15:36800	DOE/NCT–03
	15:36801	DOE/NCT–05
	15:36966	DOE/NCT–01
	15:37138	CONF-8710452–
	15:37198	UCRL–102520
	15:37243	UCRL–102154
	15:37244	UCRL–102546
	15:37297	UCID–21513
	15:37298	UCRL–102447
	15:37447	UCRL–99636
	15:37460	UCRL-CR–104212

Contract No.	Abstract No.	Report No.
	15:37501	UCRL–100089
	15:37502	UCRL–101476
	15:37512	CAPE–3017
	15:37513	CAPE–3018
	15:37514	CAPE–3019
	15:37553	UCRL-JC–103107-Rev.1
	15:37586	UCRL–21195
	15:37587	UCRL–53902
	15:37588	UCRL-ID–103443
	15:37623	UCRL–102225
	15:37653	UCRL-JC–103998
	15:37695	UCRL-JC–103406
	15:37696	UCRL-JC–104223
	15:37882	UCRL–103001
	15:37909	UCRL-JC–104221
	15:37954	UCRL–102094
	15:37955	UCRL-JC–103247
	15:38052	UCRL–102939-Rev.1
	15:38053	UCRL-JC–103311-Rev.1
	15:38271	UCRL–101179
	15:38272	UCRL–101641
	15:38273	UCRL–101643
	15:38275	UCRL-ID–104103
	15:38276	UCRL-JC–103314-Rev.1
	15:38335	UCID–21934
	15:38337	UCRL–102655
	15:38338	UCRL–102856
	15:38339	UCRL-JC–103855
	15:38340	UCRL-JC–104010
	15:38336	UCRL–21222
	Schafer (W.J.) Associates, Inc., Chelmsford, MA (USA)	
	15:38274	UCRL-CR–103896
	15:36739	CONF-8904125–
	15:36757	CONF-8904125–
	15:37221	Published article
	15:37275	Published article
	15:37278	Published article
	15:37319	Published article
	15:37365	Published article
	15:37544	Published article
	15:37590	Published article
	15:37706	Published article
	15:37723	Published article
	15:37725	Published article
	15:37734	Published article
	15:37736	Published article
	15:37742	Published article
	15:37804	Published article
	15:37856	Published article
	15:37883	Published article
	15:37888	Published article
	15:37914	Published article
	15:37920	Published article
	15:37974	Published article
	15:38308	Published article
W-7405-ENG-82	**Ames Lab., IA (USA)**	
	15:36699	IS-T–1404
	15:36832	IS-T–1469
	15:37189	IS-T–1354
	15:37190	IS-T–1471
	15:37235	IS-T–1437
	15:37349	IS-T–1347
	15:37350	IS-T–1428
	15:37351	IS-T–1470
	15:37521	IS-T–1468
	15:37616	IS-T–1395
	15:37254	Published article
	15:37255	Published article
	15:37326	Published article
	15:37975	Published article
	15:37982	Published article

Report Number Index

The report number index consists of the alphanumeric identifiers assigned to report literature as well as patent and conference literature cited in this publication. Entries provide the abstract number; the source(s) of availability of the document; the GPO file prefix for GPO depository library documents; the order number for OSTI and NTIS report ordering purposes; and, if the document was distributed under the DOE distribution program, the category number is shown for paper copy (PC), microfiche (MF), or no distribution (ND). These categories are included to assist DOE librarians in responding to requests for reports in their collections. The index also lists secondary numbers, with the corresponding abstract numbers and cross-references to other identifying numbers.

Report Number	*Abstract Number*	*Source of Availability*	*GPO Dep.*	*Order Number*	*Distribution Category*
ABC–					
4	15:37507	*See* DOE/SF/00515–T94			
5	15:37454	*See* DOE/SF/00515–T95			
6	15:37484	*See* DOE/SF/00515–T90			
7	15:37485	*See* DOE/SF/00515–T91			
8	15:37453	*See* DOE/SF/00515–T89			
9	15:37505	*See* DOE/SF/00515–T92			
10	15:37506	*See* DOE/SF/00515–T93			
AD-A–					
217970/3/XAB	15:37558	NTIS, PC A03/MF A01			
218407/5/XAB	15:37704	NTIS, PC A03/MF A01			
AECS-SDB–					
10	15:37936	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90631313	
AERE-M–					
3795	15:37042	NTIS (US Sales Only), PC A03/MF A01		DE90799625	
AFME–					
83.0097	15:36872	NTIS (US Sales Only), PC A03/MF A01		DE90501076	
84-1724-5	15:36875	NTIS (US Sales Only), PC A03/MF A01		DE90501072	
85-05-1038	15:36876	NTIS (US Sales Only), PC A03/MF A01		DE90501073	
87-91-0002(Vol.1)	15:37045	NTIS (US Sales Only), PC A15/MF A01		DE90501029	
87-91-0002(Vol.2)	15:37046	NTIS (US Sales Only), PC A20/MF A01		DE90501028	
87-91-0002(Vol.3)	15:37020	NTIS (US Sales Only), PC A14/MF A01		DE90501027	
AFME-FR–					
10	15:37141	NTIS (US Sales Only), PC A03/MF A01		DE90501022	
ALS/TR–					
90-006	15:37549	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011713	MF-706
ANL–					
90/13	15:36764	NTIS, PC A09/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013462	MF-814
90/4-Vol.8	15:36906	*See* NUREG/CR–4667-Vol.8			
ANL/APS-TM–					
6	15:37707	NTIS, PC A22/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011799	MF-411
ANL/ESD–					
5	15:37156	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011262	MF-332
7	15:36892	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011272	MF-105
ANL/ESD/TM–					
6	15:36893	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011257	MF-105
8	15:36895	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011274	MF-105
7-Vol.2	15:36894	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011798	MF-105
ANU-P–					
1019	15:37850	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630985	
1041	15:37873	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90631009	
1042	15:37884	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90631029	
1043	15:37874	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90631010	
1046	15:37708	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630660	
1048	15:37875	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90631011	
BINE–					
0004	15:37367	*See* CNIC–00124			

BMU–

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
BMU–					
1989-232	15:36765	GRM Werbeberatung - Werbemittlung - PR, Eggenstein-Leopoldshafen, (Germany, F.R.)			
BNL–					
42887	15:37280	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012872	MF-406
44618	15:37430	NTIS, PC A08/MF A01; OSTI; INIS		DE90012412	MF-414
44646	15:37663	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012229	MF-408
44684	15:36723	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012409	MF-402
44686	15:37537	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012411	MF-406
44687	15:37510	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012410	MF-404
44708	15:36869	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012873	MF-254
44710	15:37824	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012871	MF-414
44713	15:37825	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012870	MF-413
52219	15:36809	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012751	MF-515
52235	15:36766	NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012861	MF-814
BNL-NUREG–					
43991	15:37392	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008579	
44501	15:36914	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90010644	
BNWL-CC–					
2245	15:36815	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013441	MF-510
BONN-IR–					
89-15	15:37465	NTIS (US Sales Only), PC A05/MF A01		DE90501238	
89-54	15:37511	NTIS (US Sales Only), PC A05/MF A01		DE90501237	
BR–					
85(7.26-Suppl.)	15:37594	NTIS, PC A; OSTI; Publications Unit, U.S. Fish and Wildlife Service, 18th and C Streets, N.W., Mail Stop 1111, Arlington Square Building, Washington, DC 20240		TI90012612	
BRA–					
89-341R	15:37460	*See* UCRL-CR–104212			
CAPE–					
3017	15:37512	OSTI		TI90001500	ND-712
3018	15:37513	OSTI		TI90012614	ND-706
3019	15:37514	OSTI		TI90012615	ND-706
CEA-CONF–					
9776	15:38314	NTIS (US Sales Only), PC A03/MF A01		DE90500824	
9834	15:37426	NTIS (US Sales Only), PC A02/MF A01		DE90500820	
9892	15:37841	NTIS (US Sales Only), PC A02/MF A01		DE90500827	
9893	15:37890	NTIS (US Sales Only), PC A03/MF A01		DE90500829	
CEA-DAS–					
625	15:36908	NTIS (US Sales Only), PC A03/MF A01		DE90500635	
627	15:36909	NTIS (US Sales Only), PC A02/MF A01		DE90500636	
634	15:36910	NTIS (US Sales Only), PC A03/MF A01		DE90500637	
653	15:36767	NTIS (US Sales Only), PC A03/MF A01		DE90500774	
654	15:36768	NTIS (US Sales Only), PC A02/MF A01		DE90500773	
655	15:36769	NTIS (US Sales Only), PC A03/MF A01		DE90500772	
656	15:36770	NTIS (US Sales Only), PC A02/MF A01		DE90500775	
657	15:36951	NTIS (US Sales Only), PC A03/MF A01		DE90500777	
661	15:36952	NTIS (US Sales Only), PC A03/MF A01		DE90500771	
CEA-DLPC–					
89-47	15:37347	*See* FRCEA-TH–250			
CENBG–					
89-16	15:37891	NTIS (US Sales Only), PC A02/MF A01		DE90500784	
89-23	15:37892	NTIS (US Sales Only), PC A03/MF A01		DE90500785	
CESAR–					
90/15	15:38331	*See* ORNL/TM–11518			
CNIC–					
00124	15:37367	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90631085	
00181	15:37562	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90631204	
00238	15:37368	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90631086	
00263	15:37664	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90631225	
CONF-860675–		(3. international Stirling engine conference; Rome (Italy); 25-27 Jun 1986)			
4	15:37400	NTIS (US Sales Only), PC A03/MF A01 - OSTI		DE90012562	
5	15:37401	NTIS (US Sales Only), PC A03/MF A01 - OSTI		DE90012564	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8710452–		(1987 Strategic Defense Initiative Organization (SDIO) laser propulsion workshop; Los Alamos, NM (USA); 14-18 Oct 1987)			
	15:37138	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013484	MF-700
CONF-8806243–		(DPF summer study: Snowmass '88: high energy physics in the 1990s; Division of particles and fields summer study: Snowmass '88 and linear accelerator conference; Snowmass, CO (USA); Williamsburg, VA (USA); 27 Jun - 15 jul 1988; 27 jun - 15 jul 1988)			
47	15:37501	*See* UCRL–100089			
CONF-8806477–		(Advisory group meeting on commercial use of food irradiation; Vienna (Australia); 27 Jun 1988)			
	15:37659	*See* IAEA-TECDOC–544			
CONF-8806478–		(DPF summer study: Snowmass '88: high energy physics in the 1990s; Division of particles and fields summer study: Snowmass '88 and linear accelerator conference; Snowmass, CO (USA); Williamsburg, VA (USA); 27 Jun - 15 jul 1988; 27 jun - 15 jul 1988)			
1	15:37501	*See* UCRL–100089			
CONF-880695–		(1. European Particle Accelerator Conference (EPAC-1); Rome (Italy); 7-11 Jun 1988)			
	15:37427	*See* LAL-RT–88-09			
CONF-8808145–		(4. meeting of the Division of Particles and Fields of the American Physical Society (APS); Storrs, CT (USA); 15-18 Aug 1988)			
	15:37767	*See* LAL–88-56			
CONF-8808305–		(Society of Industrial Engineers Meeting (SIM); Chicago, IL (USA); 8 Aug 1988)			
1	15:36821	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012543	MF-246
CONF-880862–		(BNL workshop on glueballs, hybrids and exotic hadrons; Upton, NY (USA); 29 Aug - 1 sep 1988)			
	15:37766	*See* LAL–88-51			
CONF-8809123–		(International congress on optical science and engineering; Hamburg (Germany, F.R.); 13-23 Sep 1988)			
4	15:37537	*See* BNL–44686			
CONF-8809144–		(Transactions of the criticality alarm systems workshop; Richland, WA (USA); 20-22 Sep 1988)			
	15:36801	*See* DOE/NCT–05			
CONF-8809281–		(4. topical meeting on short wavelength coherent radiation: generation and applications; North Falmouth, MA (USA); 26-29 Sep 1988)			
2	15:37447	*See* UCRL–99636			
CONF-8809312–		(AIChE summer national conference; Denver, CO (USA); 21-24 Sep 1988)			
2	15:37144	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012421	MF-246
CONF-8809376–		(CAS CERN Accelerator School: 3. general accelerator physics course; Salamanca (Spain); 19-30 Sep 1988)			
	15:37711	*See* LAL-RT–89-02			
	15:37712	*See* LAL-RT–89-03			
CONF-8809484–		(8. International Symposium on High Energy Spin Physics; Minnesota, U (USA); 12-17 Sep 1988)			
	15:37457	*See* LAL-RT–88-13			
CONF-8810231–		(IAEA technical committee meeting on pellet injection and toroidal confinement; Gut Ising (Germany, F.R.); 24-26 Oct 1988)			
11	15:38255	NTIS, PC A02/MF A01; OSTI; INIS		DE90012791	MF-421
CONF-8810407–		(Nuclear structure workshop; Frascati (Italy); 27-28 Oct 1988)			
	15:37768	*See* LAL–88-58			
CONF-8810510–		(Meeting on expert systems and on line codes for process operating assistance; Gif-sur-Yvette (France); 6 Oct 1988)			
	15:38314	*See* CEA-CONF–9776			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-890216–		(International symposium on high T_c superconducting oxides: processing and related properties; Las Vegas, NV (USA); 27-28 Feb 1989)			
	15:37245				
CONF-8903138–		(ILL workshop on fundamental physics with slow neutrons; Grenoble (France); 8-11 Mar 1989)			
	15:37787	*See* ISN–89-40			
CONF-8903175–		(24. Recontre de Moriond conference; Les Arcs (France); 12-17 Mar 1989)			
	15:37769	*See* LAL–89-10			
	15:37771	*See* LAL–89-20			
	15:37772	*See* LAL–89-21			
CONF-890335–		(1989 IEEE particle accelerator conference; Chicago, IL (USA); 20-23 Mar 1989)			
	15:37710	*See* LAL-RT–89-01			
CONF-890379–		(Workshop on calorimetry for the SSC; Tuscaloosa, AL (USA); 13-17 Mar 1989)			
19	15:37535	*See* SSC–229			
CONF-890388–		(4. European Physical Society (EPS) seminar on international research facilities; Zagreb (Yugoslavia); 17-19 Mar 1989)			
	15:37426	*See* CEA-CONF–9834			
CONF-890406–		(International Conference 50. Years with Nuclear Fission; Gaithersburg, MD (USA); 25-28 Apr 1989)			
	15:37891	*See* CENBG–89-16			
CONF-8904125–		(Comparative studies of various shale oils symposium; Dallas, TX (USA); 9-14 Apr 1989)			
	15:36739				
	15:36755				
	15:36756				
	15:36757				
	15:36758				
CONF-8904127–		(Trace elements in petroleum geochemistry symposium; Dallas, TX (USA); 9-14 Apr 1989)			
	15:36721				
	15:36722				
CONF-8904247–		(24. Zakopane school on physics; Zakopane (Poland); 16-23 Apr 1989)			
	15:37870	*See* ISN–89-39			
CONF-890452–		(6. national conference and exhibition on hazardous wastes and hazardous materials; New Orleans, LA (USA); 12-14 Apr 1989)			
	15:37605	Hazardous Materials Control Research Institute, 9300 Columbia Blvd., Silver Spring, MD 20910 (USA)			
CONF-890491–		(International conference on fifty years of research in nuclear fission; Berlin (Germany, F.R.); 3-7 Apr 1989)			
	15:37892	*See* CENBG–89-23			
CONF-8905144–		(Tau-Charm Factory workshop; Stanford, CA (USA); 23-27 May 1989)			
17	15:37502	*See* UCRL–101476			
CONF-8905213–		(QED structure functions workshop; Ann Arbor, MI (USA); 22-25 May 1989)			
	15:37795				
	15:37796				
	15:37797				
	15:37798				
	15:37799				
	15:37800				
	15:37801				
	15:37813				
CONF-8905282–		(5. Saturne meeting; Piriac (France); 16-20 May 1989)			
	15:37841	*See* CEA-CONF–9892			
	15:37890	*See* CEA-CONF–9893			
CONF-8905288–		(Spring college of plasma physics meeting; Trieste (Italy); May 1989)			
	15:37705	*See* RAL–90-009			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8905327–		(Sulfur cycling in terrestrial systems and wetlands conference; Ontario (Canada); 22-26 May 1989)			
1	15:37613	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012601	
CONF-8905329–		(Proceedings of the 1989 CESAR/CEA workshop on autonomous mobile robots; Oak Ridge, TN (USA); 30 May - 1 jun 1989)			
	15:38331	*See* ORNL/TM–11518			
CONF-890546–		(ICHMT international seminar on fission product transport processes in reactor accidents; Dubrovnik (Yugoslavia); 22-26 May 1989)			
	15:36909	*See* CEA-DAS–627			
CONF-8906137–		(Joint NEA/CEC workshop on technical aspects of emergency planning; Brussels (Belgium); 27-29 Jun 1989)			
	15:36908	*See* CEA-DAS–625			
CONF-8906169–		(International Astronautics Federation (IAF) conference on space power; Cleveland, OH (USA); 5-7 Jun 1989)			
2	15:36925	*See* EGG-M–89264			
CONF-8906332–		(Dynamics of concentrated systems conference; Los Alamos, NM (USA); 13-15 Jun 1989)			
1	15:37740	*See* LA-UR–90-1589			
CONF-890634–		(Expert systems applications for the electric power industry conference; Orlando, FL (USA); 5-8 Jun 1989)			
2	15:36969	*See* EGG-M–89199			
CONF-890717–		(EWEC '89: European wind energy conference and exhibition; Glasgow (UK); 10-13 Jul 1989)			
4	15:36878	*See* STEV-VIND–90-7			
CONF-8907193–		(ASTM conference on bioaerosols in the indoor environment; Boulder, CO (USA); 18-21 Jul 1989)			
1	15:37655	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012167	MF-408
CONF-8907195–		(1. international symposium on radiation vulcanization of natural rubber latex; Tokyo (Japan); 26-28 Jul 1989)			
	15:36817	*See* JAERI-M–89-228			
CONF-890770–		(16. annual review of progress in quantitative nondestructive evaluation; Brunswick, ME (USA); 23-28 Jul 1989)			
12	15:37394	*See* EGG-M–89196			
CONF-890802–		(1989 synchrotron radiation instrumentation (SRI) national conference; Berkeley, CA (USA); 6-10 Aug 1989)			
31	15:37280	*See* BNL–42887			
CONF-8908235–		(Workshop on nuclear structure by gamma spectroscopy; Ibaraki (Japan); 31 Aug - 2 sep 1989)			
	15:37908	*See* RCNP-P–108			
CONF-8908236–		(4. International Symposium on Environmental Degradation of Materials in Nuclear Power Systems Water Reactors; Jekill Island GA, U (USA); 6-10 Aug 1989)			
	15:36910	*See* CEA-DAS–634			
CONF-890855–		(10. international conference on Structural Mechanics in Reactor Technology (SMIRT); Anaheim, CA (USA); 14-18 Aug 1989)			
	15:36942	American Assoc. for Structural Mechanics in Reactor Technology, P.O. Box 60860 Terminal Annex, Los Angeles, CA 90060 (USA)			
	15:36990	American Association for Structural Mechanics, P.O. Box 60860, Los Angeles, CA 90060 (USA)			
	15:36991	American Association for Structural Mechanics, P.O. Box 60860, Los Angeles, CA 90060 (USA)			
CONF-890874–		(Workshop on high heat load x-ray optics; Argonne, IL (USA); 3-5 Aug 1989)			
	15:37707	*See* ANL/APS-TM–6			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-890902–		(198. American Chemical Society national meeting; Miami, FL (USA); 10-15 Sep 1989)			
28	15:37515	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012734	MF-414
CONF-8909210–		(12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989)			
	15:37942	NTIS, PC A99/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012031	MF-414
CONF-8909229–		(Aeroballistic Range Association meeting; Paris (France); 24-28 Sep 1989)			
3	15:37549	*See* ALS/TR–90-006			
CONF-890926–		(Nuclear waste isolation in the unsaturated zone: FOCUS '89; Las Vegas, NV (USA); 18-21 Sep 1989)			
25	15:36771	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012526	MF-814
CONF-8909338–		(HAZTECH international symposium; San Francisco, CA (USA); 27-29 Sep 1989)			
1	15:36774	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012683	MF-402
CONF-8909342–		(Conference on computers in mathematics; Palo Alto, CA (USA); Sep 1989)			
1	15:38340	*See* UCRL-JC–104010			
CONF-891006–		(Joint international waste management conference; Kyoto (Japan); 23-28 Oct 1989)			
17	15:36760	*See* EGG-M–89378			
CONF-891008–		(International symposium on safety assessment of radioactive waste repositories; Paris (France); 9-12 Oct 1989)			
	15:36767	*See* CEA-DAS–653			
	15:36768	*See* CEA-DAS–654			
	15:36769	*See* CEA-DAS–655			
	15:36770	*See* CEA-DAS–656			
CONF-8910102–		(2. European conference on progress in x-ray synchrotron radiation research; Rome (Italy); 2-6 Oct 1989)			
1	15:37510	*See* BNL–44687			
CONF-8910164–		(6. annual Gatlinburg acid rain conference; Gatlinburg, TN (USA); 30-31 Oct 1989)			
	15:37679	*See* TVA/LR/NRM–89/5			
CONF-891027–		(International symposium on research reactor safety, operations and modifications; Chalk River (Canada); 23-27 Oct 1989)			
	15:36951	*See* CEA-DAS–657			
CONF-8910419–		(Institute for Electrical and Electronics Engineers (IEEE) conference; Stanford, CA (USA); 23 Oct 1989)			
1	15:38271	*See* UCRL–101179			
CONF-8910420–		(1989 IEEE-IAS annual conference; San Diego, CA (USA); 1-5 Oct 1989)			
1	15:37120	*See* LBL–27440			
CONF-891044–		(1. international conference on radioactive nuclear beams; Berkeley, CA (USA); 16-18 Oct 1989)			
11	15:37518	*See* EGG-M–89502			
CONF-891093–		(36. American Vacuum Society national vacuum symposium; Boston, MA (USA); 23-27 Oct 1989)			
2	15:37009	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012947	
CONF-891103–		(Winter meeting of the American Nuclear Society (ANS) and nuclear power and technology exhibit; San Francisco, CA (USA); 26-30 Nov 1989)			
75	15:36968	*See* EGG-M–89161			
CONF-891108–		(International symposium on recovery operation in the event of a nuclear accident or radiological emergency; Vienna (Austria); 6-10 Nov 1989)			
	15:36952	*See* CEA-DAS–661			
CONF-8911161–		(Particle astrophysics: NASA cosmic ray program for the 1990's and beyond; Greenbelt, MD (USA); 6-8 Nov 1989)			
	15:37697				
	15:37698				

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
	15:37699				
CONF-8911192–		(1989 Boulder damage symposium; Boulder, CO (USA); 1-3 Nov 1989)			
3	15:38272	*See* UCRL–101641			
4	15:38273	*See* UCRL–101643			
CONF-8911193–		(Symposium on Charpy impact test: factors and variables; Orlando, FL (USA); 8-9 Nov 1989)			
2	15:37393	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012784	
CONF-8911198–		(Workshop on laser-plasma interaction; Indore (India); 30 Nov 1989)			
	15:38039	*See* RAL–90-008			
CONF-8911199–		(Workshop on topology, field theory and superstrings; Tsukuba (Japan); 6-10 Nov 1989)			
	15:37806	*See* KEK–89-22			
CONF-8911201–		(10. annual EPRI NDE information meeting on nondestructive evaluation research progress in 1989; Palo Alto, CA (USA); 14-15 Nov 1989)			
	15:36934	*See* EPRI-NP–6609			
CONF-8911202–		(2. workshop of Japan-UK collaboration on neutron scattering research; Tsukuba (Japan); 1 Nov 1989)			
	15:37945	*See* KEK–89-19			
CONF-891292–		(Global atmospheric change and public health conference; Washington, DC (USA); 5-6 Dec 1989)			
1	15:37563	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012599	MF-402
CONF-900135–		(15. general meeting of the Division of Particles and Fields of the American Physical Society; Houston, TX (USA); 3-6 Jan 1990)			
11	15:37826	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012286	MF-414
CONF-900140–		(SPIE optics, electro-optics and laser applications in science and engineering conference and exhibition; Los Angeles, CA (USA); 15-19 Jan 1990)			
29	15:37298	*See* UCRL–102447			
CONF-900179–		(Los Alamos National Laboratory (LANL) workshop on n-p Bremsstrahlung; Los Alamos, NM (USA); 25-26 Jan 1990)			
Summs.	15:37763	*See* LA–11877-C			
CONF-900210–		(Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990)			
Vol.1	15:36772	Arizona Board of Regents, University of Arizona, Tucson, AZ 85721			ND-900
CONF-9002100–		(International Group on Research Reactors conference; Knoxville, TN (USA); 28 Feb - 2 mar 1990)			
	15:36947	NTIS, PC A12/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012973	MF-520
CONF-9002118–		(1990 Lake Louise winter institute: the standards model and beyond; Lake Louise (Canada); 18-24 Feb 1990)			
2	15:37779	*See* TRI-PP–90-20			
CONF-900264–		(Topical conference on research trends in nonlinear and relativistic effects in plasmas; San Diego, CA (USA); 5-8 Feb 1990)			
7	15:38016	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012720	MF-420
CONF-900289–		(International workshop on the polarized ion sources and polarized gas jets; Tsukuba-Shi (Japan); 12-17 Feb 1990)			
5	15:37500	*See* TRI-PP–90-8			
CONF-9003142–		(1990 joint government/industry symposium on insensitive munitions technology; White Oak, MD (USA); 13-14 Mar 1990)			
1-Rev.1	15:37553	*See* UCRL-JC–103107-Rev.1			
CONF-9003150–		(5. international conference on instrumentation for colliding beam physics; Novosibirsk (USSR); 15-21 Mar 1990)			
4	15:37534	*See* SLAC-PUB–5224			

CONF-9003150–

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
6	15:37519	*See* FNAL/C–90/46			
CONF-9003161–		(25. Rencontres de Moriond on QCD and hadronic interactions conference; International workshop on software engineering, artificial intelligence and expert systems for high energy and nuclear physics; Computing in high energy physics; Les Arcs (France); Lyon (France); Santa Fe, NM (USA); Mar 1990; 19-24 mar 1990; 9-13 apr 1990)			
3	15:38334	*See* SLAC-PUB–5242			
4	15:37757	*See* FNAL/C–90/91-E			
5	15:37759	*See* FNAL/C–90/100-E			
6	15:37755	*See* FNAL/C–90/85-E			
7	15:37758	*See* FNAL/C–90/93-E			
CONF-9003169–		(5. international conference on monoclonal antibody immunocojugates for cancer; San Diego, CA (USA); 15-17 Mar 1990)			
1	15:37647	*See* DOE/ER/60899–3			
CONF-9003170–		(High country nuclear medicine meeting; Vail, CO (USA); 12-17 Mar 1990)			
1	15:37646	*See* DOE/ER/60899–2			
CONF-9003175–		(Les Rencontres de Physique de la Vallee D'Aosta; La Thuile (Italy); 18-24 Mar 1990)			
1	15:37756	*See* FNAL/C–90/86-E			
CONF-900328–		(IEEE/LEOS/OSA topical meeting on integrated photonics research; Hilton Head Island, SC (USA); 26-28 Mar 1990)			
2	15:37954	*See* UCRL–102094			
CONF-900329–		(ACM SIGPLAN symposium on principles and practice of parallel programming; Seattle, WA (USA); 15-16 Mar 1990)			
3	15:38336	*See* UCRL–21222			
CONF-900331–		(Workshop on heavy ion physics at the alternating gradient synchrotron; Upton, NY (USA); 3-7 Mar 1990)			
10	15:37824	*See* BNL–44710			
11	15:37752	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012285	MF-414
CONF-900348–		(2. international industrial symposium on the super collider; Miami, FL (USA); 14-16 Mar 1990)			
9	15:37405	*See* FNAL-TM–1660			
CONF-900388–		(25. Rencontres de Moriond on QCD and hadronic interactions conference; International workshop on software engineering, artificial intelligence and expert systems for high energy and nuclear physics; Computing in high energy physics; Les Arcs (France); Lyon (France); Santa Fe, NM (USA); Mar 1990; 19-24 mar 1990; 9-13 apr 1990)			
2	15:38334	*See* SLAC-PUB–5242			
CONF-9004112–		(Workshop on hadron structure functions and parton distributions; Batavia, IL (USA); 26-28 Apr 1990)			
2	15:37760	*See* FNAL/C–90/118-E			
CONF-9004131–		(The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990)			
5	15:36868	*See* EGG-M–90156			
CONF-9004190–		(Computing in high energy physics; Santa Fe, NM (USA); 9-13 Apr 1990)			
8	15:38333	*See* SLAC-PUB–5241			
9	15:38334	*See* SLAC-PUB–5242			
CONF-9004213–		(International conference on solenoidal detectors for the SSC; Tsukuba (Japan); 23-25 Apr 1990)			
1	15:37520	*See* FNAL/C–90/110			
CONF-9004218–		(Emergency preparedness conference; Oak Ridge, TN (USA); 30 Apr 1990)			
1	15:36796	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012772	MF-407

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9004220–		(International workshop on nuclear dynamics; Elba (Italy); 2-7 Apr 1990)			
1	15:37881	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012788	MF-414
CONF-900450–		(Nuclear structure in the '90's; Oak Ridge, TN (USA); 23-27 Apr 1990)			
5	15:37880	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012415	MF-413
6	15:37882	*See* UCRL–103001			
CONF-900466–		(Spring meeting of the Materials Research Society; San Francisco, CA (USA); 16-21 Apr 1990)			
56	15:37238	*See* SAND–89-2802C			
60	15:37179	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012727	MF-404
61	15:37225	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012726	MF-404
62	15:37226	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012721	MF-404
63	15:37281	NTIS, PC A03/MF A01 - OSTI		DE90012789	MF-404
64	15:37987	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012940	MF-414
65	15:37196	*See* SAND–89-2857C			
66	15:37240	*See* SAND–89-3088C			
67	15:37180	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012288	MF-404
CONF-9005123–		(9. annual international symposium on the incineration of radioactive, hazardous, mixed and medical wastes: incineration conference '90; San Diego, CA (USA); 14-18 May 1990)			
4	15:36778	*See* EGG-M–89465			
CONF-9005179–		(Loss of Fluid Test final meeting (achievements of the OECD LOFT Project); Madrid (Spain); 8-11 May 1990)			
2	15:36970	*See* EGG-M–90152			
3	15:36971	*See* EGG-M–90165			
CONF-9005183–		(8. symposium on energy engineering sciences; Argonne, IL (USA); 9-11 May 1990)			
2	15:37233	*See* EGG-M–90175			
3	15:37332	*See* EGG-M–90237			
CONF-9005220–		(Community health study for a low-level radioactive waste disposal site; Syracuse, NY (USA); 11-12 May 1990)			
1	15:37663	*See* BNL–44646			
CONF-9005221–		(Interface between nuclear structure and heavy-ion reaction dynamics conference; Notre Dam, IN (USA); 24-26 May 1990)			
4	15:37869	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012730	MF-413
CONF-9005222–		(Eurocrypt '90; Aarhus (Denmark); 21-24 May 1990)			
1	15:38345	*See* SAND–89-2782C			
CONF-9005226–		(5. annual aerospace hazardous waste management; Costa Mesa, CA (USA); 22-24 May 1990)			
1	15:37283	*See* EGG-M–90228			
CONF-9005227–		(Workshop on decision support methods for the electric power industry; Boston, MA (USA); 29-31 May 1990)			
1	15:38316	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012783	MF-405
CONF-900541–		(International conference on microbial enhanced oil recovery (MEOR); Norman, OK (USA); 27 May - 1 jun 1990)			
1	15:36723	*See* BNL–44684			
CONF-900542–		(21. Institute for Electrical and Electronics Engineers photovoltaic specialists conference; Kissimmee, FL (USA); 21-25 May 1990)			
10	15:36837	*See* SAND–90-1260C			
11	15:36836	*See* SAND–90-1259C			
12	15:36844	*See* SAND–90-1201C			
13	15:37296	*See* SAND–90-1560C			
CONF-900546–		(4. conference on fossil energy materials; Oak Ridge, TN (USA); 15-17 May 1990)			
9	15:36690	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012413	MF-114
10	15:36691	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012722	MF-114
11	15:36692	NTIS, PC A03/MF A01 - OSTI		DE90012723	MF-109

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-900557–		(8. topical conference on high-temperature plasma diagnostics; Hyannis, MA (USA); 6-10 May 1990)			
5	15:38052	*See* UCRL–102939-Rev.1			
10	15:38017	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012713	MF-420
11	15:38276	*See* UCRL-JC–103314-Rev.1			
12	15:38053	*See* UCRL-JC–103311-Rev.1			
CONF-900563–		(7. symposium on radiation measurements and applications; Ann Arbor, MI (USA); 21-24 May 1990)			
11	15:37517	*See* EGG–10617-2064			
12	15:36945	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012781	MF-406
CONF-900573–		(Conference on state/local concerns in transportation of hazardous materials; St. Louis, MO (USA); 14-16 May 1990)			
1	15:36807	*See* SAND–90-7025C			
2	15:36763	*See* SAND–90-1379C			
CONF-900601–		(12. international conference on particles and nuclei; Cambridge, MA (USA); 24-29 Jun 1990)			
1	15:37825	*See* BNL–44713			
CONF-900603–		(2. European particle accelerator conference; Nice (France); 11-16 Jun 1990)			
6	15:37455	*See* FNAL/C–90/101			
7	15:37456	*See* FNAL/C–90/102			
CONF-900608–		(American Nuclear Society annual meeting; Nashville, TN (USA); 10-14 Jun 1990)			
30	15:37026	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012768	MF-400
32	15:37024	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012798	MF-400
38	15:37383	*See* SAND–90-1683C			
CONF-9006105–		(28. symposium on engineering aspects of magnetohydrodynamics; Chicago, IL (USA); 26-28 Jun 1990)			
6	15:37040	*See* DOE/ET/10815–149			
7	15:37041	*See* DOE/ET/10815–150			
8	15:37039	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012867	MF-112
CONF-9006121–		(4. international SAMPE electronic materials and processes conference; Albuquerque, NM (USA); 12-14 Jun 1990)			
6	15:37295	*See* SAND–90-0638C			
CONF-9006176–		(19. power modulator symposium; San Diego, CA (USA); Jun 1990)			
2	15:37458	*See* SAND–90-1677C			
4	15:37446	*See* SAND–90-0333C			
5	15:37410	*See* SAND–90-0061C			
6	15:37408	*See* SAND–89-3137C			
7	15:37411	*See* SAND–90-0419C			
CONF-9006192–		(Safeguards training course on nuclear material safeguards for enrichment plants; Luxembourg (Luxembourg); 18-22 Jun 1990)			
Pt.3	15:36811	*See* K/ITP–343/Pt.3			
CONF-9006200–		(1990 American Society of Ichthyologists and Herpetologists (ASIH) conference; Charleston, SC (USA); 16 Jun 1990)			
1	15:37595	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012517	MF-708
CONF-9006206–		(28. Military Operations Research Society (MORS) symposium; Annapolis, MD (USA); 12-14 Jun 1990)			
1	15:37545	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012786	
CONF-9006209–		(4. international symposium on nondestructive characterization of materials; Anapolis, MD (USA); 11-14 Jun 1990)			
1	15:37231	*See* EGG-M–89513			
CONF-9006212–		(International symposium on nuclear astrophysics: nuclei in the cosmos; Vienna (Austria); 18-22 Jun 1990)			
1	15:37696	*See* UCRL-JC–104223			
CONF-9006213–		(International Atomic Energy Agency (IAEA)-CRP on fast neutron cross-sections conference; Vienna (Austria); 20-22 Jun 1990)			
1	15:37909	*See* UCRL-JC–104221			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9006216–		(Miniworkshop on quantum chaos; Treiste (Italy); 4 Jun - 6 jul 1990)			
1	15:37943	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012292	MF-411
CONF-900634–		(7. world ceramics congress: ceramics today–tomorrow's ceramics; Montecatini Terme (Italy); 24-30 Jun 1990)			
2	15:37243	*See* UCRL–102154			
CONF-900656–		(Meeting on optical spectroscopic instrumentation and techniques for the 1990s: applications in astronomy, chemistry and physics; Las Cruces, NM (USA); 4-6 Jun 1990)			
2	15:37239	*See* SAND–89-2860C			
CONF-900676–		(83. annual meeting and exhibition of the Air and Waste Management Association; Pittsburgh, PA (USA); 24-29 Jun 1990)			
8	15:37612	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012169	
9	15:37623	*See* UCRL–102225			
CONF-900679–		(1990 Health Physics Society meeting; Anaheim, CA (USA); 24-28 Jun 1990)			
3	15:36773	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012731	MF-407
CONF-9007106–		(Institute of nuclear materials management conference; Los Angeles, CA (USA); 15-18 Jul 1990)			
3	15:37380	*See* SAND–90-0783C			
5	15:38346	*See* SAND–90-0690C			
CONF-9007111–		(8. international conference on high-power particle beams; Novosibirsk (USSR); 2-5 Jul 1990)			
1	15:38262	*See* SAND–89-2866C			
2	15:38263	*See* SAND–89-2927C			
3	15:38040	*See* SAND–89-2775C			
4	15:38261	*See* SAND–89-2845C			
5	15:37445	*See* SAND–89-2723C			
CONF-9007113–		(Workshop on transport and confinement in toroidal devices; Santander (Spain); 2 Jul 1990)			
1	15:38018	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012936	MF-420
2	15:38019	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012935	MF-420
CONF-9007114–		(SPIE conference on Raman and luminescence spectroscopies in technology; San Diego, CA (USA); 10-12 Jul 1990)			
1	15:37242	*See* SAND–90-1670C			
CONF-900736–		(Conference on nondestructive evaluation of modern ceramics; Columbus, OH (USA); 9-12 Jul 1990)			
1	15:37232	*See* EGG-M–89514			
CONF-900756–		(SPIE's international symposium on optical and optoelectronic applied science and engineering and exhibit; San Diego, CA (USA); 8-13 Jul 1990)			
5	15:37181	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012600	MF-404
6	15:37244	*See* UCRL–102546			
7	15:37538	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012733	MF-410; MF-404
8	15:37182	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012945	
9	15:37292	*See* SAND–89-2787C			
CONF-900801–		(25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990)			
1	15:36835	*See* SAND–90-1258C			
2	15:36847	*See* SAND–90-0268C			
3	15:36846	*See* SAND–89-1553C			
4	15:36717	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011101	MF-101
5	15:36709	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011113	MF-101
6	15:37142	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011110	MF-367
7	15:37155	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011100	
8	15:36887	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011162	MF-224
9	15:37227	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011147	MF-364
10	15:36859	*See* SAND–90-1236C			
11	15:36856	*See* SAND–89-3116C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
12	15:37143	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011242	MF-350
13	15:37116	NTIS, PC A02/MF A01 - OSTI		DE90012163	MF-202
14	15:37117	NTIS, PC A02/MF A01 - OSTI		DE90012136	MF-202
15	15:38258	*See* EGG-M–89521			
CONF-900802–		(200. American Chemical Society national meeting; Washington, DC (USA); 26-31 Aug 1990)			
1	15:36706	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010101	MF-105
2	15:36900	*See* LBL–28869			
CONF-900803–		(9. international heat transfer conference; Jerusalem (Israel); 26-31 Aug 1990)			
1	15:37388	*See* SAND–89-1301			
2	15:36720	*See* SAND–89-1227C			
3	15:37392	*See* BNL-NUREG–43991			
CONF-900804–		(International topical meeting on fast reactor safety; Snowbird, UT (USA); 12-16 Aug 1990)			
1	15:36915	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90004929	MF-530
2	15:36946	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90005662	MF-532
3	15:36916	NTIS, PC A03/MF A01; OSTI; INIS		DE90010087	MF-532
4	15:36953	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90010098	MF-542
5	15:36954	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90010136	MF-534
6	15:36917	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90010138	MF-541
7	15:36918	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90010059	MF-542
8	15:36919	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90010055	MF-532
9	15:36920	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90010129	MF-532
10	15:36921	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90010056	MF-530
11	15:36926	*See* LA-UR–90-1285			
12	15:36955	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90010582	MF-530
13	15:36914	*See* BNL-NUREG–44501			
14	15:36989	*See* WHC-SA–0814			
15	15:36922	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90010128	MF-542
16	15:36928	*See* WHC-SA–0813			
17	15:36956	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011095	MF-542
18	15:36957	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011096	MF-542
19	15:36958	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011156	
20	15:36959	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011169	MF-542
21	15:36937	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011157	MF-530
22	15:36960	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011158	MF-535
23	15:36923	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011159	MF-534
24	15:36961	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011150	MF-538
25	15:36924	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011173	MF-532
26	15:36938	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011175	MF-542
27	15:36962	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011176	MF-530
28	15:36963	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011148	MF-542
29	15:36987	*See* SAND–89-3029C			
CONF-900806–		(19. international conference on low temperature physics; Brighton (UK); 16-22 Aug 1990)			
1	15:37412	*See* SAND–90-0646C			
2	15:37978	*See* LA-UR–90-1013			
3	15:37406	*See* LA-UR–90-964			
4	15:38260	*See* LA-UR–90-850			
5	15:37228	NTIS, PC A02/MF A01 - OSTI		DE90009424	MF-404
7	15:37979	*See* LBL–28749			
8	15:37980	*See* LBL–28750			
9	15:37288	*See* LBL–28747			
CONF-9008101–		(American Statistical Society; Anaheim, CA (USA); 6-9 Aug 1990)			
1	15:37377	*See* LA-UR–90-1847			
2	15:38317	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012903	MF-705
CONF-9008102–		(ACM SIGGRAPH '90; Dallas, TX (USA); 6-10 Aug 1990)			
1	15:38338	*See* UCRL–102856			
CONF-9008103–		(IEEE international conference on system engineering; Pittsburg, PA (USA); 9-11 Aug 1990)			
1	15:37373	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011642	MF-406
2	15:37378	*See* SAND–90-0236C			
CONF-9008104–		(Pan American engineers: partners for progress; Washington, DC (USA); 19-24 Aug 1990)			
1	15:37027	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011641	MF-900
CONF-9008106–		(29. annual conference of metallurgists; Ontario (Canada); 26-30 Aug 1990)			
1	15:37955	*See* UCRL-JC–103247			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9008107–		(1. annual user's group; Houston, TX (USA); 16-19 Aug 1990)			
1	15:37640	*See* LA-UR–90-1568			
CONF-9008117–		(IECEC conference; Reno, NV (USA); 7-8 Aug 1990)			
1	15:37145	NTIS, PC A02/MF A01 - OSTI		DE90012203	MF-350
CONF-900814–		(7. ASTM-EURATOM symposium on reactor dosimetry; Strasbourg (France); 27-31 Aug 1990)			
1	15:36911	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90009855	
2	15:36912	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90010708	
3	15:36816	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012802	MF-413
4	15:37407	*See* SAND–89-2605C			
CONF-900817–		(LT-19 satellite conference on high-temperature superconductivity; Cambridge (UK); 13-15 Aug 1990)			
1	15:37976	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90009415	MF-410
CONF-900818–		(International conference on shock wave and high-strain-rate phenomena in materials; San Diego, CA (USA); 12-17 Aug 1990)			
1	15:37198	*See* UCRL–102520			
CONF-900821–		(3. international symposium on rock fragmentation by blasting; Brisbane (Australia); 26-31 Aug 1990)			
1	15:36754	*See* SAND–89-1895C			
2	15:37399	*See* SAND–90-1063C			
CONF-900822–		(25. IUPAP international conference on high energy physics; Singapore (Singapore); 2-8 Aug 1990)			
1	15:37773	*See* LA-UR–90-1783			
2	15:37526	*See* LA-UR–90-1784			
3	15:37992	*See* LA-UR–90-1866			
CONF-900823–		(Annual meeting of the Geothermal Resources Council and international symposium on geothermal energy; Kailua Kona, HI (USA); 20-24 Aug 1990)			
1	15:37580	*See* SAND–90-0537C			
2	15:37017	*See* SAND–89-1380C			
3	15:36860	*See* LA-UR–90-987			
4	15:36864	*See* LA-UR–90-963			
5	15:36862	*See* LA-UR–90-923			
6	15:36863	*See* LA-UR–90-932			
7	15:36870	*See* LA-UR–90-976			
8	15:36871	*See* SAND–90-0749C			
9	15:37536	*See* SAND–90-0661C			
10	15:36866	*See* EGG-M–90073			
CONF-900833–		(ACEEE summer study on energy efficiency in buildings; Pacific Grove, CA (USA); 26 Aug - 1 sep 1990)			
1	15:37033	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012728	MF-350
2	15:37118	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012769	MF-350
CONF-900837–		(ASME international conference on computers in engineering; Boston, MA (USA); 5-9 Aug 1990)			
1	15:38320	*See* LA-UR–89-3474			
2	15:37229	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010499	MF-336
3	15:38313	*See* SAND–90-1215C			
4	15:38319	*See* KCP–613-4278			
CONF-900858–		(Coal utilization and environmental control contractors review; Pittsburgh, PA (USA); 6-9 Aug 1990)			
1	15:36707	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011172	MF-105
CONF-900861–		(1990 guidance, navigation and control conference; Portland, OR (USA); 20-22 Aug 1990)			
1	15:37557	*See* SAND–89-2928C			
CONF-900862–		(Symposium on the foundations of modern physics; Joensuu (Finland); 13-17 Aug 1990)			
1	15:37812	*See* SLAC-PUB–5185			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-900873–		(1. international topical meeting on neutron radiography system design and characterization; Pembroke (Canada); 28-30 Aug 1990)			
1	15:36949	*See* SAND–90-0383C			
CONF-900874–		(1990 international conference on parallel processing; St. Charles, IL (USA); 13-17 Aug 1990)			
1	15:38337	*See* UCRL–102655			
2	15:38315	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010536	MF-405
3	15:38339	*See* UCRL-JC–103855			
CONF-900875–		(16. international conference on very large databases; Brisbane (Australia); 13-16 Aug 1990)			
1	15:38341	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90007801	
CONF-900877–		(12. international congress for electron microscopy; Seattle, WA (USA); 12-18 Aug 1990)			
1	15:37941	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008892	MF-410
2	15:37953	*See* SAND–90-0632C			
3	15:38347	*See* SAND–90-1203C			
CONF-900884–		(14. conference on applied crystallography; Cieszyn (Poland); 5-8 Aug 1990)			
1	15:37191	*See* LA-UR–90-1068			
CONF-900886–		(29. international symposium on high temperature oxidation and sulfidation processes; Hamilton (Canada); 26-30 Aug 1990)			
1	15:37183	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010149	MF-332
CONF-900892–		(ICOM '90: international congress on membranes and membrane processes; Chicago, IL (USA); 20-24 Aug 1990)			
1	15:37002	*See* SAND–90-1139C			
2	15:37151	*See* EGG-M–90133			
3	15:37150	*See* EGG-M–90130			
CONF-900893–		(12. international symposium on nonlinear acoustics; Austin, TX (USA); 26-31 Aug 1990)			
1	15:37287	*See* LA-UR–90-1348			
CONF-900894–		(IEEE international conference on systems engineering; Cincinnati, OH (USA); Aug 1990)			
1	15:37381	*See* SAND–90-1272C			
2	15:37382	*See* SAND–90-1292C			
CONF-9009154–		(IEEE international professional communication conference; Guilford (UK); 12-14 Sep 1990)			
1	15:38344	*See* LA-UR–90-1900			
CONF-900923–		(5. international conference on the physics of highly charged ions; Giessen (Germany, F.R.); 10-14 Sep 1990)			
2	15:36828	*See* SERI/TP–254-3611			
CONF-901071–		(Joint STLE-ASME tribology conference; Toronto (Canada); 7-10 Oct 1990)			
4	15:37241	*See* SAND–90-1314C			
CSTB-EN-CLI–					
86-5-L	15:36877	NTIS (US Sales Only), PC A04/MF A01		DE90501024	
CTH-RF–					
66	15:37921	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90630887	
68	15:37516	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90631442	
69	15:37922	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630888	
71	15:37923	NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS		DE90630889	
DB–					
255	15:37602	*See* RUU-GIA–1989			
DFVLR-IB–					
444-011/88	15:36845	Deutsche Forschungsanstalt fuer Luft- und Raumfahrt e.V. (DLR), Stuttgart (Germany, F.R.). Inst. fuer Technische Thermodynamik			
DGMK–					
386	15:36719	Copy held by UB/TIB Hannover			
402	15:36736	Copy held by UB/TIB Hannover			
418-1	15:36737	Copy held by UB/TIB Hannover			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DLR-Mitt.–					
89-21	15:37005	NTIS (US Sales Only), PC A03/MF A01		DE90501149	
DOD-I–					
5210.67	15:36813	*See* PB–90-194937/XAB			
DOE/AL–					
90012657	15:36843	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012657	MF-276
DOE/AL/43058–					
T3	15:37371	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012682	MF-361
DOE/BC/14204–					
6	15:36724	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012749	MF-122
DOE/CE/40626–					
T5	15:37146	NTIS, PC A13/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011131	PC-310
DOE/CE/76246–					
T14	15:37683	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012555	MF-220
T16	15:37684	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012557	MF-220
DOE/CE/76254–					
9	15:37685	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012635	MF-220
DOE/CE/90029–					
2	15:37374	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009987	MF-363
DOE/CH/10093–					
73	15:37021	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009488	MF-201; MF-202; MF-203; MF-210;
DOE/CS–					
0188	15:37029	NTIS, PC A99/MF A01 - OSTI		DE90012659	MF-350
DOE/DP/10697–					
T1	15:38020	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011439	MF-712
DOE/DP/10779–					
T1	15:38256	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011434	MF-712
DOE/DP/50066–					
T5	15:37160	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012718	MF-700
T6	15:37554	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012717	MF-700
T7	15:37559	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012716	MF-700
T8	15:37161	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012715	MF-700
DOE/EA–					
0413	15:36797	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012701	MF-630
DOE/EH–					
0133	15:37012	NTIS, PC A99/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011271	MF-630
0142	15:36798	NTIS, PC A99/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011270	MF-630
90	15:37564	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012533	MF-630
DOE/EH/79072–					
T4	15:36799	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012516	MF-607
DOE/EIA–					
0109(90/03)	15:36730	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90012686	MF-950
0149(77-89)	15:37004	NTIS, PC A18/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90012418	MF-950
0226(90/03)	15:37034	NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90012924	MF-950
0363(90)	15:36718	NTIS, PC A06/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90013084	MF-950
0474(90)	15:37035	NTIS, PC A04/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90012750	MF-950
0520(90/02)	15:36731	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90012862	MF-950
0531(86)	15:37036	NTIS, PC A13/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE90012819	MF-950
DOE/ER–					
0455P	15:37022	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011269	MF-400
0459T	15:37565	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011777	PC-402
DOE/ER/03230–					
T9	15:37753	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013443	MF-414
DOE/ER/13295–					
4	15:37340	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012887	MF-401
DOE/ER/13328–					
T1	15:37386	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012428	MF-406
DOE/ER/13359–					
4	15:37629	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012900	MF-408
DOE/ER/13408–					
1	15:36873	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012891	MF-403
DOE/ER/13580–					
3	15:37341	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012901	MF-401
DOE/ER/13648–					
7	15:37282	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012530	MF-401
DOE/ER/13713–					
4	15:36819	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012692	MF-408

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/13731–					
3	15:37630	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012627	MF-408
DOE/ER/13794–					
1	15:37631	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012805	MF-408
2	15:37632	NTIS, PC A03/MF A01 - OSTI		DE90012806	MF-408
3	15:37633	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012807	MF-408
DOE/ER/13859–					
6	15:37330	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012441	MF-401
DOE/ER/13889–					
2	15:37709	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012886	MF-412
DOE/ER/13995–					
T1	15:37634	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012442	MF-408
DOE/ER/30133–					
H1-Vol.1	15:37147	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011771	MF-400
H1-Vol.2	15:37148	NTIS, PC A16/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011770	MF-400
DOE/ER/40233–					
5	15:37754	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013435	MF-414
DOE/ER/40388–					
50	15:37893	NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012693	MF-413
DOE/ER/45214–					
5	15:37184	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012899	MF-404
DOE/ER/45326–					
3	15:37977	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012688	MF-410
DOE/ER/45355–					
2	15:37185	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012898	MF-401
DOE/ER/45378–					
2	15:37988	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012808	MF-406
DOE/ER/53194–					
3	15:38021	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013436	MF-410
DOE/ER/53196–					
146	15:38022	NTIS, PC A07/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012021	PC-426
DOE/ER/53223–					
130	15:38023	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012865	MF-420
DOE/ER/53301–					
1	15:38024	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012440	MF-421
DOE/ER/60255–					
6	15:37658	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012221	MF-408
DOE/ER/60492–					
5	15:37635	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012249	MF-408
DOE/ER/60623–					
T2	15:37636	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013461	MF-408
DOE/ER/60763–					
1	15:37643	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012491	MF-408
DOE/ER/60872–					
1	15:37644	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012494	MF-408
DOE/ER/60894–					
1	15:37645	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012438	MF-408
DOE/ER/60899–					
2	15:37646	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012426	MF-408
3	15:37647	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012425	MF-408
DOE/ER/60903–					
1	15:37665	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013013	MF-408
DOE/ER/75151–					
T1	15:37331	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012443	MF-408
DOE/ET/10815–					
149	15:37040	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012632	MF-112
150	15:37041	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012633	MF-112
DOE/EV/10053–					
T1	15:37566	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012478	MF-402
DOE/FE–					
0182P	15:37032	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012710	MF-104
DOE/ID–					
10259	15:36964	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013097	MF-523
10262	15:37157	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012685	MF-333
10271	15:36965	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012962	MF-523
10274	15:37614	NTIS, PC A14/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012969	MF-502
10278	15:36904	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013095	MF-523
DOE/ID/12481–					
2	15:36826	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011275	MF-225
DOE/ID/12754–					
T1	15:36929	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012431	MF-528

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
T2	15:36930	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012432	MF-528
T3	15:36931	NTIS, PC A08/MF A01 - OSTI		DE90012433	MF-528
DOE/MC/21023–					
2825-Vol.1	15:36888	NTIS, PC A20/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000412	PC-103
DOE/MC/21335–					
2823-Vol.1	15:36889	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000486	PC-106
DOE/MC/23266–					
2841	15:37044	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009651	PC-110
DOE/MC/23283–					
2802	15:36693	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000455	PC-109
DOE/METC–					
90-4097	15:36712	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000470	MF-103
DOE/NASA/21749–					
1	15:37230	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011261	PC-332
DOE/NCT–					
01	15:36966	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013082	MF-714
03	15:36800	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013081	MF-714
05	15:36801	NTIS, PC A09/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013080	MF-714
DOE/NE/44139–					
58	15:36775	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011904	PC-510
60	15:36776	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011969	PC-510
DOE/NV/10384–					
23-Rev.	15:37596	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012890	MF-702; MF-707
33	15:37615	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012848	MF-706; MF-705
DOE/NV/10425–					
T1	15:36867	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013053	MF-250
DOE/NV/10630–					
8	15:37567	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012182	MF-702
DOE/OR–					
884/R2	15:37375	NTIS, PC A07/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011293	MF-520
DOE/OR/21400–					
T257	15:37154	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012690	MF-400
T458	15:37030	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012863	MF-350
DOE/OSTI–					
8200-R53	15:36902	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90008285	PC-500; PC-522; PC-523; PC-530
8200-R53-Suppl.	15:36903	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90008254	PC-500; PC-522; PC-523; PC-530
DOE/PC/72007–					
T14	15:36689	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011936	PC-102
DOE/PC/79914–					
T11	15:36703	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011452	MF-113
DOE/PC/80538–					
T1	15:36694	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012251	PC-108
DOE/PC/88852–					
T2	15:36896	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011144	MF-112
DOE/PC/88860–					
T1	15:36897	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009566	PC-105
DOE/PC/88874–					
T8	15:36898	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011035	MF-105
DOE/PC/88922–					
6	15:36695	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011073	MF-102
DOE/PC/88941–					
T6	15:36704	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011082	MF-102
DOE/PC/88949–					
T6	15:36711	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011142	MF-114
DOE/PC/89769–					
T1	15:36713	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010842	MF-106
DOE/PC/89771–					
1	15:36696	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011445	MF-102
DOE/PC/89867–					
T1	15:36697	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010924	PC-113; PC-108
DOE/PC/90507–					
T13	15:36705	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012250	PC-102

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/PC/91021–					
T9	15:36899	NTIS, PC A14/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008836	PC-105
DOE/PC/91025–					
T2	15:36708	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011457	PC-105
DOE/PE/77026–					
T1	15:37149	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012430	MF-630
DOE/RL–					
90-09-Rev.1	15:36777	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011793	MF-721
DOE/SF/00515–					
T89	15:37453	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012654	MF-414
T90	15:37484	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012652	MF-414
T91	15:37485	NTIS, PC A03/MF A01; OSTI; INIS		DE90012653	MF-414
T92	15:37505	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012655	MF-414
T93	15:37506	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012656	MF-414
T94	15:37507	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012450	MF-414
T95	15:37454	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012451	MF-414
DOE/SF/17538–					
T6	15:37119	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012502	MF-232
DOE/SF/17712–					
T1	15:36874	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012889	MF-251
DTP–					
90-04	15:37789	*See* RAL–90-007			
EGG–					
10617-2064	15:37517	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012580	MF-706
10617-5059	15:37402	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012679	MF-706
10617-7002	15:37568	NTIS, PC A02/MF A01 - OSTI		DE90013470	MF-702
2535	15:36980	*See* NUREG/CR–5111			
EGG-BNCT–					
8777-Vol.4-No.2	15:37666	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013094	MF-508
EGG-EAST–					
8508	15:36967	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013096	MF-523
EGG-ESQ–					
8808	15:37667	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012968	MF-507
EGG-FSP–					
8255	15:38257	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013090	MF-504
EGG-M–					
89161	15:36968	NTIS, PC A03/MF A01; OSTI; INIS		DE90012955	MF-523
89196	15:37394	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012954	
89199	15:36969	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013091	MF-506
89264	15:36925	NTIS, PC A03/MF A01 - OSTI		DE90012965	MF-528
89378	15:36760	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012959	MF-523
89465	15:36778	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012952	MF-510
89502	15:37518	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013087	MF-413
89513	15:37231	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012960	MF-504
89514	15:37232	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012961	MF-504
89521	15:38258	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013086	MF-420
90073	15:36866	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012956	MF-251
90130	15:37150	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010933	MF-311
90133	15:37151	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010939	MF-311
90152	15:36970	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012966	MF-523
90156	15:36868	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013093	MF-256
90165	15:36971	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012957	MF-523
90175	15:37233	NTIS, PC A02/MF A01 - OSTI		DE90012953	MF-406
90228	15:37283	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012705	MF-721
90237	15:37332	NTIS, PC A02/MF A01 - OSTI		DE90013088	MF-406
EGG-MS–					
8933	15:37284	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012951	MF-504
EGG-NE–					
8940	15:36950	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013098	MF-520
EP-CECO-RA–					
1988	15:37010	NTIS (US Sales Only), PC A03/MF A01		DE90500868	
EP-CPHT-RA–					
1988	15:37989	NTIS (US Sales Only), PC A03/MF A01		DE90500850	
EP-CRG-RA–					
1988	15:38309	NTIS (US Sales Only), PC A03/MF A01		DE90500873	
EP-DCCS-RA–					
1988	15:37342	NTIS (US Sales Only), PC A03/MF A01		DE90500858	
EP-DCFI-RA–					
1988	15:37343	NTIS (US Sales Only), PC A03/MF A01		DE90500854	
EP-DCMR-RA–					
1988	15:37344	NTIS (US Sales Only), PC A03/MF A01		DE90500862	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
EP-DCPH-RA–					
1988	15:37345	NTIS (US Sales Only), PC A03/MF A01		DE90500856	
EP-DCSO-RA–					
1988	15:37346	NTIS (US Sales Only), PC A03/MF A01		DE90500860	
EP-DLAB-RA–					
1988	15:38342	NTIS (US Sales Only), PC A03/MF A01		DE90500852	
EP-LIX-RA–					
1988	15:38318	NTIS (US Sales Only), PC A03/MF A01		DE90500871	
EP-LMS-RA–					
1988	15:37162	NTIS (US Sales Only), PC A03/MF A01		DE90500833	
EP-LOA-RA–					
1988	15:37186	NTIS (US Sales Only), PC A03/MF A01		DE90500836	
EP-LULI-RA–					
1988	15:37403	NTIS (US Sales Only), PC A03/MF A01		DE90500846	
EP-MAP-RA–					
1988	15:37990	NTIS (US Sales Only), PC A03/MF A01		DE90500866	
EP-MAT-RA–					
1988	15:37991	NTIS (US Sales Only), PC A03/MF A01		DE90500864	
EP-OPTQ-RA–					
1988	15:37187	NTIS (US Sales Only), PC A03/MF A01		DE90500838	
EP-PICM-RA–					
1988	15:37285	NTIS (US Sales Only), PC A03/MF A01		DE90500831	
EP-PMC-RA–					
1988	15:37188	NTIS (US Sales Only), PC A03/MF A01		DE90500839	
EP-PMI-RA–					
1988	15:38025	NTIS (US Sales Only), PC A03/MF A01		DE90500841	
EP-PNHE-RA–					
1988	15:37751	NTIS (US Sales Only), PC A03/MF A01		DE90500843	
EP-SESI-RA–					
1988	15:37369	NTIS (US Sales Only), PC A03/MF A01		DE90500848	
EPA–					
450/2-90/007	15:37572	*See* PB–90-191982/XAB			
520/1-89/006-1	15:37575	*See* PB–90-195751/XAB			
520/1-89/006-2	15:37576	*See* PB–90-195769/XAB			
520/1-89/007	15:37577	*See* PB–90-195777/XAB			
520/1-89/034	15:37573	*See* PB–90-195603/XAB			
EPRI-EL–					
6849	15:36998	Research Reports Center, Box 50490, Palo Alto, CA 94303			
EPRI-NP–					
6609	15:36934	Research Reports Center, Box 50490, Palo Alto, CA 94303			
6815-D	15:36935	Research Reports Center, Box 50490, Palo Alto, CA 94303			
ETSU-R–					
52	15:37047	NTIS (US Sales Only), PC A09/MF A01		DE90799627	
FFA-TN–					
1989-46	15:36878	*See* STEV-VIND–90-7			
FMRC-J–					
1-OT1N9.CY	15:36799	*See* DOE/EH/79072–T4			
FNAL-TM–					
1657	15:37404	NTIS, PC A03/MF A01 - OSTI		DE90012019	PC-406
1660	15:37405	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012020	PC-406
FNAL/C–					
90/100-E	15:37759	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012664	MF-414
90/101	15:37455	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012667	MF-414
90/102	15:37456	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012896	MF-414
90/110	15:37520	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012669	MF-414
90/118-E	15:37760	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012668	MF-414
90/46	15:37519	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013003	MF-414
90/85-E	15:37755	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012845	MF-414
90/86-E	15:37756	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012846	MF-414
90/91-E	15:37757	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012665	MF-414
90/93-E	15:37758	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012847	MF-414
FR–					
60072	15:37688	*See* PB–90-184433/XAB			
7010-1	15:36897	*See* DOE/PC/88860–T1			
FRCEA-TH–					
213	15:36830	NTIS (US Sales Only), PC A09/MF A01		DE90501039	
250	15:37347	NTIS (US Sales Only), PC A07/MF A01		DE90500634	
264	15:37569	NTIS (US Sales Only), PC A09/MF A01		DE90501067	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
FRCEA-TH–					
265	15:36779	NTIS (US Sales Only), PC A11/MF A01		DE90502111	
267	15:37398	NTIS (US Sales Only), PC A07/MF A01		DE90502112	
FRNC-TH–					
3449	15:37691	NTIS (US Sales Only), PC A07/MF A01		DE90502113	
3552	15:36831	NTIS (US Sales Only), PC A06/MF A01		DE90501038	
3566	15:36728	NTIS (US Sales Only), PC A06/MF A01		DE90501068	
3567	15:36822	NTIS (US Sales Only), PC A12/MF A01		DE90501026	
3573	15:36698	NTIS (US Sales Only), PC A08/MF A01		DE90501053	
3574	15:36738	NTIS (US Sales Only), PC A12/MF A01		DE90501052	
3592	15:36936	NTIS (US Sales Only), PC A08/MF A01		DE90502110	
GA-A–					
19294	15:38259	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012985	MF-420
GKSS–					
86/E/48	15:37234	NTIS (US Sales Only), PC A07/MF A01		DE90501286	
89/E/50	15:37597	Also published in J. Geophys. Res., C (15 Oct 1989) v. 94(10) p. 14373-14379			
GL-TR–					
90-0023	15:37704	*See* AD-A–218407/5/XAB			
GRS-A–					
1589	15:36765	*See* BMU–1989-232			
IAE–					
0050	15:37368	*See* CNIC–00238			
IAEA-TECDOC–					
544	15:37659	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90631277	
548	15:37937	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90631314	
IAN–					
1984	15:38310	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90631565	
1987	15:38311	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90631566	
1988	15:38312	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90631567	
ICRU–					
45	15:37938	ICRU Publications, 7910 Woodmont Avenue, Suite 800, Bethesda, MD 20814			
IFP–					
36-859	15:37348	NTIS (US Sales Only), PC A09/MF A01		DE90500633	
36-927	15:36725	NTIS (US Sales Only), PC A11/MF A01		DE90501037	
INFO–					
0253-1	15:36913	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90630375	
INS–					
803	15:37761	NTIS (US Sales Only), PC A02/MF A01		DE90798930	
IPP–					
6/288	15:38026	NTIS (US Sales Only), PC A03/MF A01		DE90501227	
6/290	15:38027	NTIS (US Sales Only), PC A02/MF A01		DE90501229	
6/291	15:38028	NTIS (US Sales Only), PC A03/MF A01		DE90501239	
IRD–					
54-62	15:37152	NTIS (US Sales Only), PC A05/MF A01		DE90799623	
IS-T–					
1347	15:37349	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011803	MF-401
1354	15:37189	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011809	MF-401
1395	15:37616	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011620	MF-401
1404	15:36699	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011812	MF-401
1428	15:37350	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011732	MF-401
1437	15:37235	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011747	MF-401
1468	15:37521	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012448	MF-408
1469	15:36832	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012447	MF-408; MF-401
1470	15:37351	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012445	MF-401
1471	15:37190	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012446	MF-404; MF-401
ISN–					
89-39	15:37870	NTIS (US Sales Only), PC A03/MF A01		DE90500782	
89-40	15:37787	NTIS (US Sales Only), PC A02/MF A01		DE90500783	
89-42	15:37894	NTIS (US Sales Only), PC A03/MF A01		DE90500786	
ISPO–					
314	15:36814	*See* SAND–90-0806			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
JAERI-M–					
89-226	15:38029	NTIS (US Sales Only), PC A03/MF A01		DE90798729	
89-228	15:36817	NTIS (US Sales Only), PC A18/MF A01		DE90798860	
90-005	15:38030	NTIS (US Sales Only), PC A03/MF A01		DE90798730	
JAI–					
334	15:36762	*See* ORNL/Sub–89-SD841/1			
JINR-E–					
4-88-930	15:37895	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90629310	
Juel-Spez–					
541	15:36810	NTIS (US Sales Only), PC A03/MF A01		DE90501255	
551	15:37025	NTIS (US Sales Only), PC A04/MF A01		DE90501254	
K/DSRD–					
115	15:37546	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012420	
K/ETO–					
29	15:37286	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012869	MF-517
K/ITP–					
343/Pt.3	15:36811	NTIS, PC A18/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012220	MF-517
343/Pt.4	15:36812	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012611	MF-517
KAPL–					
4715	15:37236	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011785	PC-504
KCP–					
613-4278	15:38319	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012996	MF-705
KEK–					
89-8	15:37944	NTIS (US Sales Only), PC A07/MF A01		DE90798895	
89-16	15:37488	NTIS (US Sales Only), PC A03/MF A01		DE90798716	
89-19	15:37945	NTIS (US Sales Only), PC A07/MF A01		DE90798861	
89-22	15:37806	NTIS (US Sales Only), PC A17/MF A01		DE90798858	
KFK–					
4693	15:36972	NTIS (US Sales Only), PC A03/MF A01		DE90501263	
LA–					
11735-MS	15:37570	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011765	MF-902
11779-MS	15:36861	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012424	
11789-MS	15:37550	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011266	PC-741
11790-MS	15:36795	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012660	
11803-PR	15:37637	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012016	PC-408
11821-MS	15:37739	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011265	MF-910
11823-M	15:36802	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012704	
11835-MS	15:37551	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012912	MF-705
11877-C	15:37763	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012740	MF-700
11883-C	15:38343	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011792	MF-700
LA-UR–					
89-3474	15:38320	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90002407	MF-905
90-1013	15:37978	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008916	MF-410
90-1068	15:37191	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90008968	MF-404; MF-413
90-1285	15:36926	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010585	
90-1348	15:37287	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010601	MF-403
90-1568	15:37640	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012098	MF-905; MF-908
90-1589	15:37740	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011964	MF-910
90-1783	15:37773	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012058	MF-414
90-1784	15:37526	NTIS, PC A02/MF A01; OSTI; INIS		DE90012057	MF-414
90-1847	15:37377	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011998	MF-905
90-1866	15:37992	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012102	MF-414
90-1900	15:38344	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012104	MF-700
90-850	15:38260	NTIS, PC A02/MF A01 - OSTI		DE90009015	MF-701
90-923	15:36862	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008930	
90-932	15:36863	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008929	
90-963	15:36864	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008926	MF-403
90-964	15:37406	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008925	MF-406
90-976	15:36870	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008921	MF-251
90-987	15:36860	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008920	MF-251
LAL–					
88-05	15:37764	NTIS (US Sales Only), PC A03/MF A01		DE90500804	
88-25	15:37765	NTIS (US Sales Only), PC A03/MF A01		DE90500816	
88-51	15:37766	NTIS (US Sales Only), PC A03/MF A01		DE90500809	
88-56	15:37767	NTIS (US Sales Only), PC A02/MF A01		DE90500793	
88-58	15:37768	NTIS (US Sales Only), PC A03/MF A01		DE90500807	
89-10	15:37769	NTIS (US Sales Only), PC A02/MF A01		DE90500788	
89-19	15:37770	NTIS (US Sales Only), PC A09/MF A01		DE90500875	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
89-20	15:37771	NTIS (US Sales Only), PC A02/MF A01		DE90500789	
89-21	15:37772	NTIS (US Sales Only), PC A03/MF A01		DE90500791	
LAL-RT–					
88-09	15:37427	NTIS (US Sales Only), PC A03/MF A01		DE90500813	
88-13	15:37457	NTIS (US Sales Only), PC A03/MF A01		DE90500811	
89-01	15:37710	NTIS (US Sales Only), PC A02/MF A01		DE90500797	
89-02	15:37711	NTIS (US Sales Only), PC A03/MF A01		DE90500801	
89-03	15:37712	NTIS (US Sales Only), PC A03/MF A01		DE90500799	
LAO–					
2732-1856	15:37568	*See* EGG–10617-7002			
LBL–					
27440	15:37120	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012423	MF-350
28747	15:37288	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011602	MF-404
28749	15:37979	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011584	MF-410
28750	15:37980	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011585	MF-410
28869	15:36900	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011226	MF-105
LITH-MAT-R–					
89-29	15:37993	NTIS (US Sales Only), PC A10/MF A01; OSTI; INIS		DE90630604	
LMF–					
124	15:36803	*See* NUREG/CR–5489			
LPHNEP–					
88-09	15:37774	NTIS (US Sales Only), PC A07/MF A01		DE90500818	
LPNHEP–					
88-08	15:37775	NTIS (US Sales Only), PC A03/MF A01		DE90500794	
89-02	15:37776	NTIS (US Sales Only), PC A06/MF A01		DE90500776	
89-05	15:37527	NTIS (US Sales Only), PC A08/MF A01		DE90500780	
LUEDW-MED-OK–					
1010-1-40-1989	15:37648	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90631347	
LUTFD2-TFKF–					
1013-1-112-1989	15:37333	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90631037	
MISC–					
89132	15:36964	*See* DOE/ID–10259			
90032	15:36965	*See* DOE/ID–10271			
90050	15:36700	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012963	MF-502
90057	15:36904	*See* DOE/ID–10278			
90069	15:37614	*See* DOE/ID–10274			
90084	15:36701	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012958	MF-108
MPE–					
174(prepr.)	15:37692	Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik			
MPI-PAE/Exp.El.–					
222	15:37777	NTIS (US Sales Only), PC A07/MF A01		DE90501236	
NAC-AR–					
88-01	15:37428	NTIS (US Sales Only), PC A13/MF A01; OSTI; INIS		DE90630179	
89-01	15:37429	the National Accelerator Centre, PO Box 72, Faure, 7131, South Africa			
NAC-RR–					
667	15:37529	the National Accelerator Centre, Council for Scientific and Industrial Research, P.O. Box 72, Faure, 7131, South Africa			
NASA-TM–					
103130	15:37230	*See* DOE/NASA/21749–1			
NBI-HE–					
89-58	15:37809	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630621	
90-03	15:37788	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630816	
90-11	15:37810	NTIS (US Sales Only), PC A02/MF A01; OSTI; INIS		DE90630622	
90-12	15:37811	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630623	
NG–					
18-182	15:36746	American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209 $50.00			
18-183	15:36747	American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209 $50.00			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
18-184	15:36748	American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209 $50.00		DE90012841	
NIPER–					
476	15:36726	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012687	MF-122; MF-125
NIRS-RSD–					
85	15:37660	NTIS (US Sales Only), PC A03/MF A01		DE90798892	
86	15:37598	NTIS (US Sales Only), PC A03/MF A01		DE90798893	
87	15:37661	NTIS (US Sales Only), PC A03/MF A01		DE90798894	
NUREG–					
0540-Vol.12-No.2	15:36933	NTIS, PC A14/MF A01 - GPO; OSTI; INIS		TI90013079	
0837-Vol.10-No.1	15:36973	NTIS, PC A10/MF A01 - GPO; OSTI; INIS		TI90012980	
1352	15:36974	NTIS, PC A03/MF A01 - GPO; OSTI; INIS		TI90012673	
1372	15:36905	NTIS, PC A03/MF A01 - GPO; OSTI; INIS		TI90012677	
1410	15:36975	NTIS, PC A22/MF A01 - GPO; OSTI; INIS		TI90013078	
NUREG/CR–					
4525	15:36979	NTIS, PC A04/MF A01 - GPO; OSTI; INIS		TI90013466	
4667-Vol.8	15:36906	NTIS, PC A03/MF A01 - GPO; OSTI; INIS		TI90012661	
4816	15:36907	NTIS, PC A06/MF A01 - GPO; OSTI; INIS		TI90012676	
5111	15:36980	NTIS, PC A20/MF A01 - GPO; OSTI; INIS		TI90012904	
5377	15:37599	NTIS, PC A06/MF A01 - GPO; OSTI; INIS		TI90012232	
5439	15:36939	NTIS, PC A09/MF A01 - GPO; OSTI; INIS		TI90012913	
5480	15:36944	NTIS, PC A04/MF A01 - GPO; OSTI; INIS		TI90012739	
5489	15:36803	NTIS, PC A05/MF A01 - GPO; OSTI; INIS		TI90012914	
NUREG/IA–					
0011	15:36981	NTIS, PC E07/MF E01 - GPO; OSTI; INIS		TI90013442	
0022	15:36982	NTIS, PC E05/MF E01 - GPO - OSTI		TI90012844	
OECD/LOFT-T–					
3907	15:36983	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013022	MF-523
3908	15:36984	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012392	MF-523
ORNL–					
6572	15:38321	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011300	
6574	15:36818	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012741	MF-413
6578	15:37836	NTIS, PC A13/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012022	PC-410
6591	15:36804	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011301	MF-721
6596	15:37327	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012002	MF-401
6601	15:37192	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012049	PC-904
6606	15:37334	NTIS, PC A07/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012024	PC-401
6608/R2	15:37013	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012003	MF-630
6608/R3	15:37014	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012004	MF-630
6608/R4	15:37015	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012005	MF-630
6615	15:37560	NTIS, PC A14/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012030	
6626	15:37139	NTIS, PC A13/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012006	MF-330
6628	15:37561	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012007	
ORNL/CDIAC–					
32	15:37571	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011298	MF-402
ORNL/CON–					
297	15:37121	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011294	MF-310
299	15:37037	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011295	MF-900
300	15:37038	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011296	MF-350
ORNL/CSD/TM–					
269	15:37547	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011299	MF-705
ORNL/FTR–					
2810	15:37552	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012349	MF-741
2845	15:36780	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012336	MF-511
2851	15:37670	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012352	MF-407
2875	15:37686	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012381	MF-407; MF-408
2887	15:36940	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012369	
2898	15:37714	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012376	MF-411
2916	15:36985	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012276	MF-523
2923	15:38322	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012368	MF-405
2925	15:37837	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012366	MF-413
2956	15:37652	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012379	MF-408
2968	15:36833	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012374	MF-400; MF-401
2981	15:38323	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012382	MF-405
2998	15:38324	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012365	MF-405
3000	15:37899	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012373	MF-413
3008	15:37289	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012358	MF-401
3038	15:38325	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012360	MF-405

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
ORNL/FTR–					
3039	15:38326	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012310	MF-408; MF-406
3057	15:37931	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012362	
3071	15:37741	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012356	MF-410
3074	15:37016	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012383	MF-407
3080	15:36761	NTIS, PC A03/MF A01 - OSTI		DE90012308	MF-610
3101	15:36986	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012274	
3103	15:38327	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012273	MF-705
3114	15:36781	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012275	MF-721
3129	15:37674	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012391	MF-402
3147	15:37950	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012252	MF-411
3157	15:37675	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012390	MF-407; MF-402
3162	15:38328	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012389	MF-405
3623	15:37876	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012742	MF-414
3624	15:38031	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012213	MF-421
3628	15:37671	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012106	MF-408
3635	15:37838	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012744	MF-413
3640	15:36932	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012743	MF-528
3643	15:37290	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012804	MF-404
3647	15:36927	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012905	MF-523; MF-530
ORNL/M–					
1121	15:38329	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011291	MF-705
1137	15:37043	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012026	PC-528
1140	15:37375	*See* DOE/OR–884/R2			
1142	15:37676	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011273	
1143	15:37677	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011290	
1149	15:36805	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012974	MF-511
1173	15:37122	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011289	MF-350
1175-Vol.1	15:37617	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012982	
1188	15:37140	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012976	MF-335
ORNL/NSP–					
90/3	15:37031	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011292	MF-500
ORNL/Sub–					
84-00214/1	15:37237	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012029	MF-332
86-7685/2	15:37000	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012023	MF-202
89-SD841/1	15:36762	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012025	PC-812; PC-513
ORNL/TM–					
10328	15:36907	*See* NUREG/CR–4816			
11149	15:37678	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012033	
11159	15:37193	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012972	MF-365
11175	15:36759	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012050	PC-526
11202	15:37715	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012034	MF-426
11274	15:37548	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012036	
11291	15:37123	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012037	MF-350
11296	15:36941	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011268	MF-405
11301	15:36901	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012745	
11319	15:36939	*See* NUREG/CR–5439			
11380	15:37539	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012038	MF-411
11399	15:36944	*See* NUREG/CR–5480			
11425	15:37124	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012039	MF-350
11442	15:37716	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012027	PC-420
11448	15:37159	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012040	MF-950
11477	15:38330	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012041	MF-405
11490	15:37885	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011267	MF-413; MF-405
11495	15:36782	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012042	MF-610
11502	15:37600	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011278	MF-402
11511	15:37001	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011279	
11518	15:38331	NTIS, PC A18/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011283	MF-405
11532	15:37932	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011280	
11535	15:36806	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011281	MF-400
11540	15:37335	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011282	MF-401
11547	15:37886	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011284	MF-413
11557	15:37530	NTIS, PC A07/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011285	MF-406
1175-Vol.2	15:37618	NTIS, PC A22/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012978	
PARAMETER/IE–					
155	15:36979	*See* NUREG/CR–4525			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
PATENTS-USA–					
Application7-429,426	15:37425	NTISPC N03/MF A01			
PB–					
90-182395/XAB	15:36783	NTIS, PC A09/MF A02			
90-183500/XAB	15:37981	NTIS, PC A03/MF A01			
90-184433/XAB	15:37688	NTIS, PC A03/MF A01			
90-191982/XAB	15:37572	NTIS, PC A09/MF A01			
90-193095/XAB	15:37291	NTIS, PC A05/MF A01			
90-194937/XAB	15:36813	NTIS, PC A01/MF A01			
90-195363/XAB	15:37693	NTIS, PC A08/MF A01			
90-195371/XAB	15:37694	NTIS, PC A09/MF A01			
90-195603/XAB	15:37573	NTIS, PC A06/MF A01			
90-195736/XAB	15:37574	NTIS, PC EE99/MF E99			
90-195751/XAB	15:37575	NTIS, PC A24/MF A03			
90-195769/XAB	15:37576	NTIS, PC A16/MF A02			
90-195777/XAB	15:37577	NTIS, PC A23/MF A03			
90-198177/XAB	15:37619	NTIS, PC A07/MF A01			
90-202748/XAB	15:37442	NTIS, PC A06/MF A01			
90-864083/XAB	15:37578	NTISPC N01/MF N01			
90-865528/XAB	15:37153	NTISPC N01/MF N01			
90-866633/XAB	15:37620	NTISPC N01/MF N01			
90-915700/XAB	15:37689	NTISSubscription			
90-928500/XAB	15:37011	NTISSubscription			
90-928600/XAB	15:36732	NTISSubscription			
PIRSEM–					
2035	15:36834	NTIS (US Sales Only), PC A03/MF A01		DE90501075	
2099-1	15:37006	NTIS (US Sales Only), PC A05/MF A01		DE90501025	
252-1	15:36865	NTIS (US Sales Only), PC A03/MF A01		DE90501074	
3130	15:37007	NTIS (US Sales Only), PC A04/MF A01		DE90501023	
8680.N.200	15:37125	NTIS (US Sales Only), PC A09/MF A01		DE90501077	
PNL–					
6109	15:37126	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012444	MF-350
6429	15:37127	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012434	MF-350
6441	15:37128	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012435	MF-350
6450-31-HEDR	15:37579	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012747	MF-707
6779	15:36784	NTIS, PC A13/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011794	MF-702
7331	15:36785	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011774	MF-602
7337	15:37008	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012674	MF-950
7338	15:36729	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012675	MF-950
7344	15:36786	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011767	MF-602
7355	15:36787	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011779	MF-721
7370	15:37687	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012748	
7379	15:37601	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012746	MF-813
PPPL–					
2697	15:38032	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011264	PC-426; PC-427
2699	15:38033	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011263	PC-426
2700	15:38034	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012018	PC-420; PC-426
2703	15:38035	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012017	PC-420; PC-421; PC-427
2707	15:38036	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013500	PC-426
PR–					
140-709	15:36750	American Gas Association, 1515 Wilson Blvd., Arlington, VA 22209 $50.00			
15-633	15:36744	American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209; $50.00			
164-804	15:36735	American Gas Association, 1515 Wilson Blvd., Arlington, VA 22209 $50.00			
185-815-Vol.1	15:36751	American Gas Assoc., 1515 Wilson Blvd., Arlington, VA 22209 $25.00			
185-815-Vol.2	15:36752	American Gas Assoc., 1515 Wilson Blvd., Arlington, VA 22209 $25.00			
187-821	15:37194	American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209 $50.00			
3-805	15:36749	American Gas Association, 1515 Wilson Boulevard, Arlington, VA 22209 $100.00			
PSC–					
1	15:38037	NTIS (US Sales Only), PC A03/MF A01		DE90798728	
5	15:38038	NTIS (US Sales Only), PC A03/MF A01		DE90798727	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
RAL–					
90-003	15:37443	NTIS (US Sales Only), PC A08/MF A01; OSTI; INIS		DE90631374	
90-007	15:37789	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630817	
90-008	15:38039	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630699	
90-009	15:37705	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90631220	
90-010	15:37790	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630818	
90-011	15:37444	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90631375	
RCNP-P–					
108	15:37908	NTIS (US Sales Only), PC A09/MF A01		DE90798857	
RFP–					
4072	15:37195	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011253	PC-704
RISO-M–					
2779	15:36743	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90631179	
RISO-R–					
574	15:37952	NTIS (US Sales Only), PC A06/MF A01; OSTI; INIS		DE90630673	
RUU-GIA–					
1989	15:37602	Library KNAW; P.O. Box 41950, 1009 DD Amsterdam (Netherlands)			
SAAS-Miti–					
89-13	15:37940	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90629996	
SAND–					
89-0371	15:36788	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011255	MF-721
89-1227C	15:36720	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90006540	MF-126
89-1301	15:37388	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90002833	MF-706
89-1380C	15:37017	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008346	MF-250
89-1553C	15:36846	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011022	MF-700
89-1895C	15:36754	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009569	MF-706
89-2605C	15:37407	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013064	MF-706
89-2723C	15:37445	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013495	MF-700
89-2775C	15:38040	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013497	MF-712
89-2782C	15:38345	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012159	MF-700
89-2787C	15:37292	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013494	MF-704
89-2802C	15:37238	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012224	MF-704; MF-701
89-2845C	15:38261	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013401	MF-712
89-2857C	15:37196	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012919	MF-404
89-2860C	15:37239	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012921	MF-404
89-2866C	15:38262	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013071	MF-712
89-2927C	15:38263	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012920	MF-414
89-2928C	15:37557	NTIS, PC A02/MF A01 - OSTI		DE90005239	MF-700
89-3029C	15:36987	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012184	
89-3088C	15:37240	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012999	MF-704
89-3116C	15:36856	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011474	MF-237
89-3137C	15:37408	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013063	
89-7088	15:36702	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011259	MF-102
89-7139	15:37293	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012010	MF-274
89-7149	15:36789	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011787	MF-721
90-0048	15:37409	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011801	MF-700
90-0061C	15:37410	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013062	
90-0217	15:37294	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011256	MF-404
90-0236C	15:37378	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012186	MF-706
90-0268C	15:36847	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011021	MF-700
90-0333C	15:37446	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013061	
90-0366	15:37379	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011781	PC-812
90-0383C	15:36949	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90007072	MF-706
90-0419C	15:37411	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013076	MF-706
90-0537C	15:37580	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008347	MF-702
90-0632C	15:37953	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009322	MF-405
90-0638C	15:37295	NTIS, PC A03/MF A01 - OSTI		DE90013072	MF-706
90-0646C	15:37412	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90008738	MF-700
90-0661C	15:37536	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009348	MF-706
90-0690C	15:38346	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012917	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
90-0749C	15:36871	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009284	MF-703
90-0783C	15:37380	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013000	MF-706
90-0795	15:38332	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012009	MF-905
90-0806	15:36814	NTIS, PC A03/MF A01; GPO Dep.	E 1.99:	DE90011254	MF-515
90-1063C	15:37399	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009568	MF-706
90-1139C	15:37002	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009741	MF-213
90-1201C	15:36844	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012758	MF-276
90-1203C	15:38347	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010832	MF-741
90-1215C	15:38313	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009747	MF-705
90-1236C	15:36859	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011507	MF-276
90-1258C	15:36835	NTIS, PC A02/MF A01 - OSTI		DE90010847	MF-275
90-1259C	15:36836	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012754	MF-275
90-1260C	15:36837	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012644	MF-275
90-1272C	15:37381	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010824	MF-706
90-1292C	15:37382	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012183	MF-706
90-1314C	15:37241	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011053	
90-1379C	15:36763	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012763	MF-722
90-1560C	15:37296	NTIS, PC A02/MF A01 - OSTI		DE90013070	MF-270
90-1670C	15:37242	NTIS, PC A03/MF A01 - OSTI		DE90012915	MF-704
90-1677C	15:37458	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012586	MF-706
90-1683C	15:37383	NTIS, PC A02/MF A01 - OSTI		DE90013069	MF-722
90-7003	15:37499	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011258	MF-706
90-7025C	15:36807	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012762	MF-722
90-8217	15:37197	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011754	MF-704
SERI/PR–					
215-3617	15:36827	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90000307	MF-233; MF-234
SERI/TP–					
254-3611	15:36828	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009516	MF-350
SERI/TR–					
215-3482	15:36829	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009455	MF-234; MF-270
SGCISN–					
8940	15:36988	NTIS (US Sales Only), PC A05/MF A01		DE90500787	
SGD–					
546-PT-1	15:37693	*See* PB–90-195363/XAB			
546-PT-2	15:37694	*See* PB–90-195371/XAB			
SKB-TR–					
88-32	15:36790	NTIS (US Sales Only), PC A07/MF A01; OSTI; INIS		DE90631514	
89-19	15:36791	NTIS (US Sales Only), PC A11/MF A01; OSTI; INIS		DE90631518	
89-22	15:37603	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90631175	
89-24	15:37604	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90631176	
SLAC-CN–					
376	15:37459	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012449	MF-414
SLAC-PUB–					
5185	15:37812	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90006456	PC-414
5212	15:37533	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011252	MF-414
5224	15:37534	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011800	MF-414
5241	15:38333	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011797	MF-405
5242	15:38334	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90011796	MF-405
SMC–					
0021	15:37562	*See* CNIC–00181			
0027	15:37664	*See* CNIC–00263			
SRDP-R–					
163	15:36814	*See* SAND–90-0806			
SSC–					
229	15:37535	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013016	MF-414
STEV-VIND–					
90-7	15:36878	NTIS (US Sales Only), PC A03/MF A01		DE90796237	
SWEG-R–					
41	15:37129	British Library, Document Supply Centre, Boston Spa, Wetherby, West Yorks.			
TRI-PP–					
90-8	15:37500	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE90013102	
90-13	15:37794	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE90013103	
90-20	15:37779	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE90013106	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
TRITA-PFU–					
89-01	15:38041	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630691	
89-02	15:38042	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630692	
89-03	15:38043	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630703	
89-04	15:38044	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630693	
89-05	15:38045	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630704	
89-06	15:38046	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630696	
89-07	15:38047	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630694	
89-08	15:38048	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630697	
89-09	15:38049	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630705	
89-10	15:38050	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630706	
90-01	15:38051	NTIS (US Sales Only), PC A03/MF A01; OSTI; INIS		DE90630700	
TTC–					
0983	15:36763	*See* SAND–90-1379C			
TVA/LR/NRM–					
89/5	15:37679	NTIS, PC A05/MF A01 - OSTI		DE90012825	
TVA/PUB–					
89/10	15:37583	NTIS, PC A06/MF A01; OSTI; INIS		DE90012820	
89/8	15:37581	NTIS, PC A06/MF A01; OSTI; INIS		DE90012822	
89/9	15:37582	NTIS, PC A06/MF A01; OSTI; INIS		DE90012821	
TVA/WR/WQ–					
89/3	15:37018	NTIS, PC A22/MF A01; OSTI; Tennessee Valley Authority, Evans Building, Room 1W 141A, Knoxville, TN 37902		DE90012824	
90/6	15:37621	NTIS, PC A07/MF A01 - OSTI		DE90012823	
UBA-FB–					
89-063	15:37680	Copy held by UB/TIB Hannover			
89-098	15:37584	Copy held by UB/TIB Hannover			
89-138	15:37622	Copy held by UB/TIB Hannover			
89-150	15:37158	Copy held by UB/TIB Hannover			
89-158	15:37681	Copy held by UB/TIB Hannover			
90-025/7	15:37585	Copy held by UB/TIB Hannover			
UCID–					
21513	15:37297	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010373	MF-706
21934	15:38335	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013512	MF-705
UCR/IGPP–					
88/27	15:36873	*See* DOE/ER/13408–1			
UCRL–					
100089	15:37501	NTIS, PC A02/MF A01 - OSTI		DE90012986	
100587	15:37512	*See* CAPE–3017			
101179	15:38271	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012078	MF-700
101476	15:37502	NTIS, PC A02/MF A01 - OSTI		DE90012878	
101641	15:38272	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013483	MF-712
101643	15:38273	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013485	MF-712
102094	15:37954	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012894	
102154	15:37243	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013481	MF-701
102225	15:37623	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012988	MF-702
102447	15:37298	NTIS, PC A02/MF A01 - OSTI		DE90012992	MF-406; MF-401
102520	15:37198	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90009950	
102546	15:37244	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012703	MF-706
102655	15:38337	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90007258	MF-705
102856	15:38338	NTIS, PC A03/MF A01 - OSTI		DE90012070	MF-706; MF-705
102939-Rev.1	15:38052	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013474	MF-420
103001	15:37882	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013477	MF-413
21195	15:37586	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013057	
21222	15:38336	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012866	MF-405
53902	15:37587	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012015	PC-603
99636	15:37447	NTIS, PC A02/MF A01 - OSTI		DE90012895	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
UCRL-CR–					
103896	15:38274	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013068	MF-712
104212	15:37460	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013065	
UCRL-ID–					
103443	15:37588	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012995	MF-402
104103	15:38275	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90011276	MF-420
UCRL-JC–					
103107-Rev.1	15:37553	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012467	MF-742
103247	15:37955	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012074	MF-401
103311-Rev.1	15:38053	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013066	MF-420; MF-405
103314-Rev.1	15:38276	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013067	MF-420
103406	15:37695	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012993	MF-700
103855	15:38339	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010862	MF-700
103998	15:37653	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012989	MF-708
104010	15:38340	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013051	MF-705
104221	15:37909	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90013475	MF-700
104223	15:37696	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90013473	MF-700
USARIEM-T–					
1-90	15:37558	*See* AD-A–217970/3/XAB			
USGS-OFR–					
89-3	15:37690	NTIS, PC A08/MF A01; OSTI; INIS; USGS Books and Open File Reports Section, Box 25425 Federal Center, Denver, CO 80225; GPO Dep.	E 1.99:	DE90013464	
UTK–					
90-3	15:37790	*See* RAL–90-010			
UUIP–					
1186	15:37956	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90630674	
VTT-TIED–					
1018	15:36792	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90631519	
1032	15:36793	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90631520	
1073	15:36794	NTIS (US Sales Only), PC A08/MF A01; OSTI; INIS		DE90631507	
VTT-TUTK–					
639	15:37199	NTIS (US Sales Only), PC A04/MF A01; OSTI; INIS		DE90631154	
653	15:37395	NTIS (US Sales Only), PC A05/MF A01; OSTI; INIS		DE90631385	
WAST–					
90012584	15:36999	OSTI; Westinghouse Electric Corporation, Research and Development Department, Advanced Systems Technology, Pittsburgh, PA 15235		TI90012584	
WHC-EP–					
0145-2	15:37624	NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90012640	MF-902
WHC-SA–					
0813	15:36928	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE90010837	MF-537
0814	15:36989	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90010855	MF-530
Y/DK–					
669	15:38007	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE90012885	MF-701; MF-704

Order Number Correlation

The correlation list is provided for those organizations that file documents by report number but may receive requests by order number. For more information about a document, refer to the Report Number Index.

Order No.	Report No.
DE89009455	SERI/TR–215-3482
DE89009488	DOE/CH/10093–73
DE89009516	SERI/TP–254-3611
DE90000307	SERI/PR–215-3617
DE90000412	DOE/MC/21023–2825-Vol.1
DE90000455	DOE/MC/23283–2802
DE90000470	DOE/METC–90-4097
DE90000486	DOE/MC/21335–2823-Vol.1
DE90002407	LA-UR–89-3474
DE90002833	SAND–89-1301
DE90004929	CONF-900804–1
DE90005239	SAND–89-2928C
DE90005662	CONF-900804–2
DE90006456	SLAC-PUB–5185
DE90006540	SAND–89-1227C
DE90007072	SAND–90-0383C
DE90007258	UCRL–102655
DE90007801	CONF-900875–1
DE90008254	DOE/OSTI–8200-R53-Suppl.
DE90008285	DOE/OSTI–8200-R53
DE90008346	SAND–89-1380C
DE90008347	SAND–90-0537C
DE90008579	BNL-NUREG–43991
DE90008738	SAND–90-0646C
DE90008836	DOE/PC/91021–T9
DE90008892	CONF-900877–1
DE90008916	LA-UR–90-1013
DE90008920	LA-UR–90-987
DE90008921	LA-UR–90-976
DE90008925	LA-UR–90-964
DE90008926	LA-UR–90-963
DE90008929	LA-UR–90-932
DE90008930	LA-UR–90-923
DE90008968	LA-UR–90-1068
DE90009015	LA-UR–90-850
DE90009284	SAND–90-0749C
DE90009322	SAND–90-0632C
DE90009348	SAND–90-0661C
DE90009415	CONF-900817–1
DE90009424	CONF-900806–5
DE90009566	DOE/PC/88860–T1
DE90009568	SAND–90-1063C
DE90009569	SAND–89-1895C
DE90009651	DOE/MC/23266–2841
DE90009741	SAND–90-1139C
DE90009747	SAND–90-1215C
DE90009855	CONF-900814–1
DE90009950	UCRL–102520
DE90009987	DOE/CE/90029–2
DE90010055	CONF-900804–8
DE90010056	CONF-900804–10
DE90010059	CONF-900804–7
DE90010087	CONF-900804–3
DE90010098	CONF-900804–4
DE90010101	CONF-900802–1
DE90010128	CONF-900804–15
DE90010129	CONF-900804–9
DE90010136	CONF-900804–5
DE90010138	CONF-900804–6
DE90010149	CONF-900886–1
DE90010373	UCID–21513
DE90010499	CONF-900837–2
DE90010536	CONF-900874–2
DE90010582	CONF-900804–12
DE90010585	LA-UR–90-1285
DE90010601	LA-UR–90-1348
DE90010644	BNL-NUREG–44501
DE90010708	CONF-900814–2
DE90010824	SAND–90-1272C
DE90010832	SAND–90-1203C
DE90010837	WHC-SA–0813
DE90010842	DOE/PC/89769–T1
DE90010847	SAND–90-1258C
DE90010855	WHC-SA–0814
DE90010862	UCRL-JC–103855
DE90010924	DOE/PC/89867–T1
DE90010933	EGG-M–90130
DE90010939	EGG-M–90133
DE90011021	SAND–90-0268C
DE90011022	SAND–89-1553C
DE90011035	DOE/PC/88874–T8
DE90011053	SAND–90-1314C
DE90011073	DOE/PC/88922–6
DE90011082	DOE/PC/88941–T6
DE90011095	CONF-900804–17
DE90011096	CONF-900804–18
DE90011100	CONF-900801–7
DE90011101	CONF-900801–4
DE90011110	CONF-900801–6
DE90011113	CONF-900801–5
DE90011131	DOE/CE/40626–T5
DE90011142	DOE/PC/88949–T6
DE90011144	DOE/PC/88852–T2
DE90011147	CONF-900801–9
DE90011148	CONF-900804–28
DE90011150	CONF-900804–24
DE90011156	CONF-900804–19
DE90011157	CONF-900804–21
DE90011158	CONF-900804–22
DE90011159	CONF-900804–23
DE90011162	CONF-900801–8
DE90011169	CONF-900804–20
DE90011172	CONF-900858–1
DE90011173	CONF-900804–25
DE90011175	CONF-900804–26
DE90011176	CONF-900804–27
DE90011226	LBL–28869
DE90011242	CONF-900801–12
DE90011252	SLAC-PUB–5212
DE90011253	RFP–4072
DE90011254	SAND–90-0806
DE90011255	SAND–89-0371
DE90011256	SAND–90-0217
DE90011257	ANL/ESD/TM–6
DE90011258	SAND–90-7003
DE90011259	SAND–89-7088
DE90011261	DOE/NASA/21749–1
DE90011262	ANL/ESD–5
DE90011263	PPPL–2699
DE90011264	PPPL–2697
DE90011265	LA–11821-MS
DE90011266	LA–11789-MS
DE90011267	ORNL/TM–11490
DE90011268	ORNL/TM–11296
DE90011269	DOE/ER–0455P
DE90011270	DOE/EH–0142
DE90011271	DOE/EH–0133
DE90011272	ANL/ESD–7
DE90011273	ORNL/M–1142
DE90011274	ANL/ESD/TM–8
DE90011275	DOE/ID/12481–2
DE90011276	UCRL-ID–104103
DE90011278	ORNL/TM–11502
DE90011279	ORNL/TM–11511
DE90011280	ORNL/TM–11532
DE90011281	ORNL/TM–11535
DE90011282	ORNL/TM–11540
DE90011283	ORNL/TM–11518
DE90011284	ORNL/TM–11547
DE90011285	ORNL/TM–11557
DE90011289	ORNL/M–1173
DE90011290	ORNL/M–1143
DE90011291	ORNL/M–1121
DE90011292	ORNL/NSP–90/3
DE90011293	DOE/OR–884/R2
DE90011294	ORNL/CON–297
DE90011295	ORNL/CON–299
DE90011296	ORNL/CON–300
DE90011298	ORNL/CDIAC–32
DE90011299	ORNL/CSD/TM–269
DE90011300	ORNL–6572
DE90011301	ORNL–6591
DE90011434	DOE/DP/10779–T1
DE90011439	DOE/DP/10697–T1
DE90011445	DOE/PC/89771–1
DE90011452	DOE/PC/79914–T11
DE90011457	DOE/PC/91025–T2
DE90011474	SAND–89-3116C
DE90011507	SAND–90-1236C
DE90011584	LBL–28749
DE90011585	LBL–28750
DE90011602	LBL–28747
DE90011620	IS-T–1395
DE90011641	CONF-9008104–1
DE90011642	CONF-9008103–1
DE90011713	ALS/TR–90-006
DE90011732	IS-T–1428
DE90011747	IS-T–1437
DE90011754	SAND–90-8217
DE90011765	LA–11735-MS
DE90011767	PNL–7344
DE90011770	DOE/ER/30133–H1-Vol.2
DE90011771	DOE/ER/30133–H1-Vol.1
DE90011774	PNL–7331
DE90011777	DOE/ER–0459T
DE90011779	PNL–7355
DE90011781	SAND–90-0366
DE90011785	KAPL–4715
DE90011787	SAND–89-7149
DE90011792	LA–11883-C
DE90011793	DOE/RL–90-09-Rev.1
DE90011794	PNL–6779
DE90011796	SLAC-PUB–5242

Order No.	Report No.	Order No.	Report No.	Order No.	Report No.
DE90011797	SLAC-PUB-5241	DE90012249	DOE/ER/60492-5	DE90012494	DOE/ER/60872-1
DE90011798	ANL/ESD/TM-7-Vol.2	DE90012250	DOE/PC/90507-T13	DE90012502	DOE/SF/17538-T6
DE90011799	ANL/APS-TM-6	DE90012251	DOE/PC/80538-T1	DE90012516	DOE/EH/79072-T4
DE90011800	SLAC-PUB-5224	DE90012252	ORNL/FTR-3147	DE90012517	CONF-9006200-1
DE90011801	SAND-90-0048	DE90012273	ORNL/FTR-3103	DE90012526	CONF-890928-25
DE90011803	IS-T-1347	DE90012274	ORNL/FTR-3101	DE90012530	DOE/ER/13648-7
DE90011809	IS-T-1354	DE90012275	ORNL/FTR-3114	DE90012533	DOE/EH-90
DE90011812	IS-T-1404	DE90012276	ORNL/FTR-2916	DE90012543	CONF-8808305-1
DE90011904	DOE/NE/44139-58	DE90012285	CONF-900331-11	DE90012555	DOE/CE/76246-T14
DE90011936	DOE/PC/72007-T14	DE90012286	CONF-900135-11	DE90012557	DOE/CE/76246-T16
DE90011964	LA-UR-90-1589	DE90012288	CONF-900466-67	DE90012562	CONF-860676-4
DE90011969	DOE/NE/44139-60	DE90012292	CONF-9006216-1	DE90012564	CONF-860676-5
DE90011998	LA-UR-90-1847	DE90012308	ORNL/FTR-3080	DE90012580	EGG-10617-2064
DE90012002	ORNL-6596	DE90012310	ORNL/FTR-3039	DE90012586	SAND-90-1677C
DE90012003	ORNL-6608/R2	DE90012336	ORNL/FTR-2845	DE90012599	CONF-891292-1
DE90012004	ORNL-6608/R3	DE90012349	ORNL/FTR-2810	DE90012600	CONF-900756-5
DE90012005	ORNL-6608/R4	DE90012352	ORNL/FTR-2851	DE90012601	CONF-8905327-1
DE90012006	ORNL-6626	DE90012356	ORNL/FTR-3071	DE90012611	K/ITP-343/Pt.4
DE90012007	ORNL-6628	DE90012358	ORNL/FTR-3008	DE90012627	DOE/ER/13731-3
DE90012009	SAND-90-0795	DE90012360	ORNL/FTR-3038	DE90012632	DOE/ET/10815-149
DE90012010	SAND-89-7139	DE90012362	ORNL/FTR-3057	DE90012633	DOE/ET/10815-150
DE90012015	UCRL-53902	DE90012365	ORNL/FTR-2998	DE90012635	DOE/CE/76254-9
DE90012016	LA-11803-PR	DE90012366	ORNL/FTR-2925	DE90012640	WHC-EP-0145-2
DE90012017	PPPL-2703	DE90012368	ORNL/FTR-2923	DE90012644	SAND-90-1260C
DE90012018	PPPL-2700	DE90012369	ORNL/FTR-2887	DE90012652	DOE/SF/00515-T90
DE90012019	FNAL-TM-1657	DE90012373	ORNL/FTR-3000	DE90012653	DOE/SF/00515-T91
DE90012020	FNAL-TM-1660	DE90012374	ORNL/FTR-2968	DE90012654	DOE/SF/00515-T89
DE90012021	DOE/ER/53198-146	DE90012376	ORNL/FTR-2898	DE90012655	DOE/SF/00515-T92
DE90012022	ORNL-6578	DE90012379	ORNL/FTR-2956	DE90012656	DOE/SF/00515-T93
DE90012023	ORNL/Sub-86-7685/2	DE90012381	ORNL/FTR-2875	DE90012657	DOE/AL-90012657
DE90012024	ORNL-6606	DE90012382	ORNL/FTR-2981	DE90012659	DOE/CS-0188
DE90012025	ORNL/Sub-89-SD841/1	DE90012383	ORNL/FTR-3074	DE90012660	LA-11790-MS
DE90012026	ORNL/M-1137	DE90012389	ORNL/FTR-3162	DE90012664	FNAL/C-90/100-E
DE90012027	ORNL/TM-11442	DE90012390	ORNL/FTR-3157	DE90012665	FNAL/C-90/91-E
DE90012029	ORNL/Sub-84-00214/1	DE90012391	ORNL/FTR-3129	DE90012667	FNAL/C-90/101
DE90012030	ORNL-6615	DE90012392	OECD/LOFT-T-3908	DE90012668	FNAL/C-90/118-E
DE90012031	CONF-8909210-	DE90012409	BNL-44684	DE90012669	FNAL/C-90/110
DE90012033	ORNL/TM-11149	DE90012410	BNL-44687	DE90012674	PNL-7337
DE90012034	ORNL/TM-11202	DE90012411	BNL-44686	DE90012675	PNL-7338
DE90012036	ORNL/TM-11274	DE90012412	BNL-44618	DE90012679	EGG-10617-5059
DE90012037	ORNL/TM-11291	DE90012413	CONF-900546-9	DE90012682	DOE/AL/43058-T3
DE90012038	ORNL/TM-11380	DE90012415	CONF-900450-5	DE90012683	CONF-8909338-1
DE90012039	ORNL/TM-11425	DE90012418	DOE/EIA-0149(77-89)	DE90012685	DOE/ID-10262
DE90012040	ORNL/TM-11448	DE90012420	K/DSRD-115	DE90012686	DOE/EIA-0109(90/03)
DE90012041	ORNL/TM-11477	DE90012421	CONF-8809312-2	DE90012687	NIPER-476
DE90012042	ORNL/TM-11495	DE90012423	LBL-27440	DE90012688	DOE/ER/45326-3
DE90012049	ORNL-6601	DE90012424	LA-11779-MS	DE90012690	DOE/OR/21400-T257
DE90012050	ORNL/TM-11175	DE90012425	DOE/ER/60899-3	DE90012692	DOE/ER/13713-4
DE90012057	LA-UR-90-1784	DE90012426	DOE/ER/60899-2	DE90012693	DOE/ER/40388-50
DE90012058	LA-UR-90-1783	DE90012428	DOE/ER/13328-T1	DE90012701	DOE/EA-0413
DE90012070	UCRL-102856	DE90012430	DOE/PE/77026-T1	DE90012703	UCRL-102546
DE90012074	UCRL-JC-103247	DE90012431	DOE/ID/12754-T1	DE90012704	LA-11823-M
DE90012078	UCRL-101179	DE90012432	DOE/ID/12754-T2	DE90012705	EGG-M-90228
DE90012098	LA-UR-90-1568	DE90012433	DOE/ID/12754-T3	DE90012710	DOE/FE-0182P
DE90012102	LA-UR-90-1866	DE90012434	PNL-6429	DE90012713	CONF-900557-10
DE90012104	LA-UR-90-1900	DE90012435	PNL-6441	DE90012715	DOE/DP/50066-T8
DE90012106	ORNL/FTR-3628	DE90012438	DOE/ER/60894-1	DE90012716	DOE/DP/50066-T7
DE90012136	CONF-900801-14	DE90012440	DOE/ER/53301-1	DE90012717	DOE/DP/50066-T6
DE90012159	SAND-89-2782C	DE90012441	DOE/ER/13859-6	DE90012718	DOE/DP/50066-T5
DE90012163	CONF-900801-13	DE90012442	DOE/ER/13995-T1	DE90012720	CONF-900264-7
DE90012167	CONF-8907193-1	DE90012443	DOE/ER/75151-T1	DE90012721	CONF-900466-62
DE90012169	CONF-900676-8	DE90012444	PNL-6109	DE90012722	CONF-900546-10
DE90012182	DOE/NV/10630-8	DE90012445	IS-T-1470	DE90012723	CONF-900546-11
DE90012183	SAND-90-1292C	DE90012446	IS-T-1471	DE90012726	CONF-900466-61
DE90012184	SAND-89-3029C	DE90012447	IS-T-1469	DE90012727	CONF-900466-60
DE90012186	SAND-90-0236C	DE90012448	IS-T-1468	DE90012728	CONF-900833-1
DE90012203	CONF-9008117-1	DE90012449	SLAC-CN-376	DE90012730	CONF-9005221-4
DE90012213	ORNL/FTR-3624	DE90012450	DOE/SF/00515-T94	DE90012731	CONF-900679-3
DE90012220	K/ITP-343/Pt.3	DE90012451	DOE/SF/00515-T95	DE90012733	CONF-900756-7
DE90012221	DOE/ER/60255-6	DE90012467	UCRL-JC-103107-Rev.1	DE90012734	CONF-890902-28
DE90012224	SAND-89-2802C	DE90012478	DOE/EV/10053-T1	DE90012740	LA-11877-C
DE90012229	BNL-44646	DE90012491	DOE/ER/60763-1	DE90012741	ORNL-6574

Order No.	Report No.	Order No.	Report No.	Order No.	Report No.
DE90012742	ORNL/FTR–3623	DE90012917	SAND–90-0690C	DE90013093	EGG-M–90156
DE90012743	ORNL/FTR–3640	DE90012919	SAND–89-2857C	DE90013094	EGG-BNCT–8777-Vol.4-No.2
DE90012744	ORNL/FTR–3635	DE90012920	SAND–89-2927C	DE90013095	DOE/ID–10278
DE90012745	ORNL/TM–11301	DE90012921	SAND–89-2860C	DE90013096	EGG-EAST–8508
DE90012746	PNL–7379	DE90012924	DOE/EIA–0226(90/03)	DE90013097	DOE/ID–10259
DE90012747	PNL–6450-31-HEDR	DE90012935	CONF-9007113–2	DE90013098	EGG-NE–8940
DE90012748	PNL–7370	DE90012936	CONF-9007113–1	DE90013102	TRI-PP–90-8
DE90012749	DOE/BC/14204–6	DE90012940	CONF-900466–64	DE90013103	TRI-PP–90-13
DE90012750	DOE/EIA–0474(90)	DE90012945	CONF-900756–8	DE90013106	TRI-PP–90-20
DE90012751	BNL–52219	DE90012947	CONF-891093–2	DE90013401	SAND–89-2845C
DE90012754	SAND–90-1259C	DE90012951	EGG-MS–8933	DE90013435	DOE/ER/40233–5
DE90012758	SAND–90-1201C	DE90012952	EGG-M–89465	DE90013436	DOE/ER/53194–3
DE90012762	SAND–90-7025C	DE90012953	EGG-M–90175	DE90013441	BNWL-CC–2245
DE90012763	SAND–90-1379C	DE90012954	EGG-M–89196	DE90013443	DOE/ER/03230–T9
DE90012768	CONF-900608–30	DE90012955	EGG-M–89161	DE90013461	DOE/ER/60623–T2
DE90012769	CONF-900833–2	DE90012956	EGG-M–90073	DE90013462	ANL–90/13
DE90012772	CONF-9004218–1	DE90012957	EGG-M–90165	DE90013464	USGS-OFR–89-3
DE90012781	CONF-900563–12	DE90012958	MISC–90084	DE90013470	EGG–10617-7002
DE90012783	CONF-9005227–1	DE90012959	EGG-M–89378	DE90013473	UCRL-JC–104223
DE90012784	CONF-8911193–2	DE90012960	EGG-M–89513	DE90013474	UCRL–102939-Rev.1
DE90012786	CONF-9006206–1	DE90012961	EGG-M–89514	DE90013475	UCRL-JC–104221
DE90012788	CONF-9004220–1	DE90012962	DOE/ID–10271	DE90013477	UCRL–103001
DE90012789	CONF-900466–63	DE90012963	MISC–90050	DE90013481	UCRL–102154
DE90012791	CONF-8810231–11	DE90012965	EGG-M–89264	DE90013483	UCRL–101641
DE90012798	CONF-900608–32	DE90012966	EGG-M–90152	DE90013484	CONF-8710452–
DE90012802	CONF-900814–3	DE90012968	EGG-ESQ–8808	DE90013485	UCRL–101643
DE90012804	ORNL/FTR–3643	DE90012969	DOE/ID–10274	DE90013494	SAND–89-2787C
DE90012805	DOE/ER/13794–1	DE90012972	ORNL/TM–11159	DE90013495	SAND–89-2723C
DE90012806	DOE/ER/13794–2	DE90012973	CONF-9002100–	DE90013497	SAND–89-2775C
DE90012807	DOE/ER/13794–3	DE90012974	ORNL/M–1149	DE90013500	PPPL–2707
DE90012808	DOE/ER/45378–2	DE90012976	ORNL/M–1188	DE90013512	UCID–21934
DE90012819	DOE/EIA–0531(86)	DE90012978	ORNL/TM–1175-Vol.2	DE90500633	IFP–36-859
DE90012820	TVA/PUB–89/10	DE90012982	ORNL/M–1175-Vol.1	DE90500634	FRCEA-TH–250
DE90012821	TVA/PUB–89/9	DE90012985	GA-A–19294	DE90500635	CEA-DAS–625
DE90012822	TVA/PUB–89/8	DE90012986	UCRL–100089	DE90500636	CEA-DAS–627
DE90012823	TVA/WR/WQ–90/6	DE90012988	UCRL–102225	DE90500637	CEA-DAS–634
DE90012824	TVA/WR/WQ–89/3	DE90012989	UCRL-JC–103998	DE90500771	CEA-DAS–661
DE90012825	TVA/LR/NRM–89/5	DE90012992	UCRL–102447	DE90500772	CEA-DAS–655
DE90012841	NG–18-184	DE90012993	UCRL-JC–103406	DE90500773	CEA-DAS–654
DE90012845	FNAL/C–90/85-E	DE90012995	UCRL-ID–103443	DE90500774	CEA-DAS–653
DE90012846	FNAL/C–90/86-E	DE90012996	KCP–613-4278	DE90500775	CEA-DAS–656
DE90012847	FNAL/C–90/93-E	DE90012999	SAND–89-3088C	DE90500776	LPNHEP–89-02
DE90012848	DOE/NV/10384–33	DE90013000	SAND–90-0783C	DE90500777	CEA-DAS–657
DE90012861	BNL–52235	DE90013003	FNAL/C–90/46	DE90500780	LPNHEP–89-05
DE90012862	DOE/EIA–0520(90/02)	DE90013013	DOE/ER/60903–1	DE90500782	ISN–89-39
DE90012863	DOE/OR/21400–T458	DE90013016	SSC–229	DE90500783	ISN–89-40
DE90012865	DOE/ER/53223–130	DE90013022	OECD/LOFT-T–3907	DE90500784	CENBG–89-16
DE90012866	UCRL–21222	DE90013051	UCRL-JC–104010	DE90500785	CENBG–89-23
DE90012867	CONF-9006105–8	DE90013053	DOE/NV/10425–T1	DE90500786	ISN–89-42
DE90012869	K/ETO–29	DE90013057	UCRL–21195	DE90500787	SGCISN–8940
DE90012870	BNL–44713	DE90013061	SAND–90-0333C	DE90500788	LAL–89-10
DE90012871	BNL–44710	DE90013062	SAND–90-0061C	DE90500789	LAL–89-20
DE90012872	BNL–42887	DE90013063	SAND–89-3137C	DE90500791	LAL–89-21
DE90012873	BNL–44708	DE90013064	SAND–89-2605C	DE90500793	LAL–88-56
DE90012878	UCRL–101476	DE90013065	UCRL-CR–104212	DE90500794	LPNHEP–88-08
DE90012885	Y/DK–669	DE90013066	UCRL-JC–103311-Rev.1	DE90500797	LAL-RT–89-01
DE90012886	DOE/ER/13889–2	DE90013067	UCRL-JC–103314-Rev.1	DE90500799	LAL-RT–89-03
DE90012887	DOE/ER/13295–4	DE90013068	UCRL-CR–103896	DE90500801	LAL-RT–89-02
DE90012889	DOE/SF/17712–T1	DE90013069	SAND–90-1683C	DE90500804	LAL–88-05
DE90012890	DOE/NV/10384–23-Rev.	DE90013070	SAND–90-1560C	DE90500807	LAL–88-58
DE90012891	DOE/ER/13408–1	DE90013071	SAND–89-2866C	DE90500809	LAL–88-51
DE90012894	UCRL–102094	DE90013072	SAND–90-0638C	DE90500811	LAL-RT–88-13
DE90012895	UCRL–99636	DE90013076	SAND–90-0419C	DE90500813	LAL-RT–88-09
DE90012896	FNAL/C–90/102	DE90013080	DOE/NCT–05	DE90500816	LAL–88-25
DE90012898	DOE/ER/45355–2	DE90013081	DOE/NCT–03	DE90500818	LPHNEP–88-09
DE90012899	DOE/ER/45214–5	DE90013082	DOE/NCT–01	DE90500820	CEA-CONF–9834
DE90012900	DOE/ER/13359–4	DE90013084	DOE/EIA–0363(90)	DE90500824	CEA-CONF–9776
DE90012901	DOE/ER/13580–3	DE90013086	EGG-M–89521	DE90500827	CEA-CONF–9892
DE90012903	CONF-9008101–2	DE90013087	EGG-M–89502	DE90500829	CEA-CONF–9893
DE90012905	ORNL/FTR–3647	DE90013088	EGG-M–90237	DE90500831	EP-PICM-RA–1988
DE90012912	LA–11835-MS	DE90013090	EGG-FSP–8255	DE90500833	EP-LMS-RA–1988
DE90012915	SAND–90-1670C	DE90013091	EGG-M–89199	DE90500836	EP-LOA-RA–1988

Order No.	Report No.
DE90500838	EP-OPTQ-RA–1988
DE90500839	EP-PMC-RA–1988
DE90500841	EP-PMI-RA–1988
DE90500843	EP-PNHE-RA–1988
DE90500846	EP-LULI-RA–1988
DE90500848	EP-SESI-RA–1988
DE90500850	EP-CPHT-RA–1988
DE90500852	EP-DLAB-RA–1988
DE90500854	EP-DCFI-RA–1988
DE90500856	EP-DCPH-RA–1988
DE90500858	EP-DCCS-RA–1988
DE90500860	EP-DCSO-RA–1988
DE90500862	EP-DCMR-RA–1988
DE90500864	EP-MAT-RA–1988
DE90500866	EP-MAP-RA–1988
DE90500868	EP-CECO-RA–1988
DE90500871	EP-LIX-RA–1988
DE90500873	EP-CRG-RA–1988
DE90500875	LAL–89-19
DE90501022	AFME-FR–10
DE90501023	PIRSEM–3130
DE90501024	CSTB-EN-CLI–86-5-L
DE90501025	PIRSEM–2099-1
DE90501026	FRNC-TH–3567
DE90501027	AFME–87-91-0002(Vol.3)
DE90501028	AFME–87-91-0002(Vol.2)
DE90501029	AFME–87-91-0002(Vol.1)
DE90501037	IFP–36-927
DE90501038	FRNC-TH–3552
DE90501039	FRCEA-TH–213
DE90501052	FRNC-TH–3574
DE90501053	FRNC-TH–3573
DE90501067	FRCEA-TH–264
DE90501066	FRNC-TH–3566
DE90501072	AFME–84-1724-5
DE90501073	AFME–85-05-1038
DE90501074	PIRSEM–252-1
DE90501075	PIRSEM–2035
DE90501076	AFME–83.0097
DE90501077	PIRSEM–8680.N.200
DE90501149	DLR-Mitt.–89-21
DE90501227	IPP–6/288
DE90501229	IPP–6/290
DE90501236	MPI-PAE/Exp.El.–222
DE90501237	BONN-IR–89-54
DE90501238	BONN-IR–89-15
DE90501239	IPP–6/291
DE90501254	Juel-Spez–551
DE90501255	Juel-Spez–541
DE90501263	KFK–4693
DE90501286	GKSS–86/E/48
DE90502110	FRNC-TH–3592
DE90502111	FRCEA-TH–265
DE90502112	FRCEA-TH–267
DE90502113	FRNC-TH–3449
DE90629310	JINR-E–4-88-930
DE90629996	SAAS-Mitt–89-13
DE90630179	NAC-AR–88-01
DE90630375	INFO–0253-1
DE90630604	LITH-MAT-R–89-29
DE90630621	NBI-HE–89-58
DE90630622	NBI-HE–90-11
DE90630623	NBI-HE–90-12
DE90630660	ANU-P–1046
DE90630673	RISO-R–574
DE90630674	UUIP–1186
DE90630691	TRITA-PFU–89-01
DE90630692	TRITA-PFU–89-02
DE90630693	TRITA-PFU–89-04
DE90630694	TRITA-PFU–89-07
DE90630696	TRITA-PFU–89-06
DE90630697	TRITA-PFU–89-08
DE90630699	RAL–90-008
DE90630700	TRITA-PFU–90-01
DE90630703	TRITA-PFU–89-03
DE90630704	TRITA-PFU–89-05
DE90630705	TRITA-PFU–89-09
DE90630706	TRITA-PFU–89-10
DE90630816	NBI-HE–90-03
DE90630817	RAL–90-007
DE90630818	RAL–90-010
DE90630887	CTH-RF–66
DE90630888	CTH-RF–69
DE90630889	CTH-RF–71
DE90630985	ANU-P–1019
DE90631009	ANU-P–1041
DE90631010	ANU-P–1043
DE90631011	ANU-P–1048
DE90631029	ANU-P–1042
DE90631037	LUTFD2-TFKF–1013-1-112-1989
DE90631085	CNIC–00124
DE90631086	CNIC–00238
DE90631154	VTT-TUTK–639
DE90631175	SKB-TR–89-22
DE90631176	SKB-TR–89-24
DE90631179	RISO-M–2779
DE90631204	CNIC–00181
DE90631220	RAL–90-009
DE90631225	CNIC–00263
DE90631277	IAEA-TECDOC–544
DE90631313	AECS-SDB–10
DE90631314	IAEA-TECDOC–548
DE90631347	LUEDW-MED-OK–1010-1-40-1989
DE90631374	RAL–90-003
DE90631375	RAL–90-011
DE90631385	VTT-TUTK–653
DE90631442	CTH-RF–68
DE90631507	VTT-TIED–1073
DE90631514	SKB-TR–88-32
DE90631518	SKB-TR–89-19
DE90631519	VTT-TIED–1018
DE90631520	VTT-TIED–1032
DE90631565	IAN–1984
DE90631566	IAN–1987
DE90631567	IAN–1988
DE90796237	STEV-VIND–90-7
DE90798716	KEK–89-16
DE90798727	PSC–5
DE90798728	PSC–1
DE90798729	JAERI-M–89-226
DE90798730	JAERI-M–90-005
DE90798857	RCNP-P–108
DE90798858	KEK–89-22
DE90798860	JAERI-M–89-228
DE90798861	KEK–89-19
DE90798892	NIRS-RSD–85
DE90798893	NIRS-RSD–86
DE90798894	NIRS-RSD–87
DE90798895	KEK–89-8
DE90798930	INS–803
DE90799623	IRD–54-62
DE90799625	AERE-M–3795
DE90799627	ETSU-R–52
TI90001500	CAPE–3017
TI90012232	NUREG/CR–5377
TI90012584	WAST–90012584
TI90012612	BR–85(7.26-Suppl.)
TI90012614	CAPE–3018
TI90012615	CAPE–3019
TI90012661	NUREG/CR–4667-Vol.8
TI90012673	NUREG–1352
TI90012676	NUREG/CR–4816
TI90012677	NUREG–1372
TI90012739	NUREG/CR–5480
TI90012844	NUREG/IA–0022
TI90012904	NUREG/CR–5111
TI90012913	NUREG/CR–5439
TI90012914	NUREG/CR–5489
TI90012980	NUREG–0837-Vol.10-No.1
TI90013078	NUREG–1410
TI90013079	NUREG–0540-Vol.12-No.2
TI90013442	NUREG/IA–0011
TI90013466	NUREG/CR–4525

Codes Used on Index Lines

Following the citation numbers in the Corporate Author, Personal Author, and Subject Indexes, codes are used to designate the type of document, country of publication, and language of the document, e.g., (R;SU;In Russian). The language designator does not appear if the document is published in English.

Document Types

J Journal article
TJ Translation of a journal article
R Report
RA Report analytic
B Book
BA Book analytic
P Patent
E Engineering materials
D Dissertation
TG Translation (general)
TA Translation (analytic)

Country Codes

AD Andorra
AE United Arab Emirates
AF Afghanistan
AL Albania
AR Argentina
AT Austria
AU Australia

BB Barbados
BD Bangladesh
BE Belgium
BG Bulgaria
BH Bahrain
BI Burundi
BJ Benin
BM Bermuda
BO Bolivia
BR Brazil
BS Bahamas
BT Bhutan
BU Burma
BW Botswana
BY Byelorussian Soviet Socialist Republic (Byelorussian SSR)

CA Canada
CB Khmer Republic
CF Central African Republic
CG Congo
CH Switzerland
CI Ivory Coast
CL Chile
CM United Republic of Cameroon
CN China
CO Colombia
CR Costa Rica
CS Czechoslovakia
CU Cuba
CY Cyprus

DD German Democratic Republic
DE Germany, Fed. Republic of (F.R. Germany)
DK Denmark
DO Dominican Republic
DZ Algeria

EC Ecuador
EG Egypt
ES Spain
ET Ethiopia

FI Finland
FJ Fiji
FR France

GA Gabon
GB United Kingdom of Great Britain and Northern Ireland (UK)
GD Grenada
GH Ghana
GM Gambia
GN Guinea
GQ Equatorial Guinea
GR Greece
GT Guatemala
GU Guam
GW Guinea-Bissau
GY Guyana

HK Hong Kong
HN Honduras
HT Haiti
HU Hungary
HV Upper Volta

ID Indonesia
IE Ireland
IL Israel
IN India
IQ Iraq
IR Iran
IS Iceland
IT Italy

JM Jamaica
JO Jordan
JP Japan

KE Kenya
KH Democratic Kampuchea
KP Democratic People's Republic of Korea
KR Korea, Republic of
KW Kuwait

LA Laos
LB Lebanon
LI Liechtenstein
LK Sri Lanka
LR Liberia
LS Lesotho
LU Luxembourg
LY Libyan Arab Republic

MA Morocco
MC Monaco
MG Madagascar
ML Mali
MN Mongolia
MR Mauritania
MT Malta
MU Mauritius
MV Maldives
MW Malawi
MX Mexico
MY Malaysia

NE Niger
NG Nigeria
NI Nicaragua
NL Netherlands
NO Norway
NP Nepal
NR Nauru
NZ New Zealand

OM Oman

PA Panama
PE Peru
PG Papua New Guinea
PH Philippines
PK Pakistan
PL Poland
PR Puerto Rico
PT Portugal
PY Paraguay

QA Qatar

RH Southern Rhodesia
RO Romania
RW Rwanda

SA Saudi Arabia
SD Sudan
SE Sweden
SG Singapore
SK Sikkim
SL Sierra Leone
SM San Marino
SN Senegal
SO Somalia
SU Union of Soviet Socialist Republics (USSR)
SV El Salvador
SY Syria
SZ Swaziland

TD Chad
TG Togo
TH Thailand
TN Tunisia
TO Tonga
TR Turkey
TT Trinidad and Tobago
TW Taiwan
TZ United Republic of Tanzania

UA Ukrainian Soviet Socialist Republic (Ukrainian SSR)
UG Uganda
US United States of America (USA)
UY Uruguay

VA Holy See
VE Venezuela
VI Virgin Islands of the United States
VN Viet Nam

WS Western Samoa

YD Democratic Yemen
YE Yemen
YU Yugoslavia

ZA South Africa
ZM Zambia
ZR Zaire
ZW Zimbabwe

*U.S.GOVERNMENT PRINTING OFFICE:1990-748-113:20006

ORDER FORM

DOE and DOE Contractors: Fill in Parts I, II, and IV. **Others:** Fill in Parts I, III, and IV. Mark appropriate blanks in Part IV to indicate quantity and form (microfiche or paper copy).

I. SHIPPING AND PAYMENT INFORMATION

Ordering Address

Name _____ Telephone _____

Address _____

City _____ State _____ Zip _____

Shipping Address (if different from above)

Name _____

Address _____

City _____ State _____ Zip _____

_____

SIGNATURE (Required to validate ALL orders)

II. OSTI ORDERS (DOE and DOE contractors can order from OSTI.)

☐ Charge OSTI deposit account no. _____

Mail orders to: U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

III. NTIS ORDERS

☐ Charge NTIS deposit account no.

☐ Check/Money Order enclosed for $

☐ Charge to my ☐ American Express ☐ VISA ☐ Mastercard

_____ _____
Account Number **Card expiration date**

☐ Ship and Bill (see below for restrictions)

Employer identification number (9 digits) _ _–_ _ _ _ _ _ _

Purchase Order number _____

Phone number of billing office _____
(Required for Ship & Bill orders)

Ship & Bill service is restricted to North American business locations for an extra $7.50 per order (or per Custom Search). The business' employer identification number plus the phone number of the office paying the bill are required to process these requests. A late payment charge will be applied to billings more than 30 days overdue. Prepaying, using an NTIS Deposit Account or a charge account, speeds order processing. Be sure payment and order are sent together. Checks, payable to NTIS, must be in U.S. dollars.

Mail orders to: U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

IF NO METHOD OF PAYMENT IS INDICATED, YOUR ORDER WILL BE RETURNED TO YOU AS A PRICE QUOTE UNPROCESSED.

IV. SELECTIONS

Order number _____ Report number _____

Abstract number (with vol., issue) _____

No. of fiche _____ No. of paper copies _____

Order number _____ Report number _____

Abstract number (with vol., issue) _____

No. of fiche _____ No. of paper copies _____

Order number _____ Report number _____

Abstract number (with vol., issue) _____

No. of fiche _____ No. of paper copies _____

Order number _____ Report number _____

Abstract number (with vol., issue) _____

No. of fiche _____ No. of paper copies _____

Order number _____ Report number _____

Abstract number (with vol., issue) _____

No. of fiche _____ No. of paper copies _____

Order number _____ Report number _____

Abstract number (with vol., issue) _____

No. of fiche _____ No. of paper copies _____

CUT OUT APPROPRIATE FORM AND MAIL IN A STAMPED ENVELOPE TO THE ADDRESS INDICATED.

Change of Address Form

NAME–FIRST, LAST

COMPANY NAME OR ADDITIONAL ADDRESS LINE

STREET ADDRESS

CITY | STATE | ZIP CODE

PLEASE PRINT OR TYPE

(or) COUNTRY

MAIL THIS FORM TO:

NEW ADDRESS
Superintendent of Documents
Government Printing Office SSOM
Washington, D.C. 20402

Attach last subscription label here.

Subscription Order Form

Enter my Subscription to: _____
(Please indicate publication)

@ $ _____ Domestic; @ $ _____ Foreign.

NAME–FIRST, LAST

COMPANY NAME OR ADDITIONAL ADDRESS LINE

STREET ADDRESS

CITY | STATE | ZIP CODE

PLEASE PRINT OR TYPE

(or) COUNTRY

☐ Remittance Enclosed (Make checks payable to Superintendent of Documents)

☐ Charge to my Deposit Account No. _____

MAIL ORDER FORM TO:
Superintendent of Documents
Government Printing Office
Washington, D.C. 20402

Federal Depository Library Program

As a result of an agreement between the U.S. Government Printing Office (GPO) and the Department of Energy, beginning in 1984 DOE reports with unlimited distribution are now included in the Federal Depository Library Program. The Regional Depository Libraries listed below receive and retain at least one copy of nearly every Federal Government publication, either in printed or microfilm form, for use by the general public. These libraries provide reference services and interlibrary loans; however, they are not sales outlets. You may wish to ask your local library to contact a Regional Depository to help you locate specific publications, or you may contact the Regional Depository yourself. Do not send checks or orders to these libraries.

ARKANSAS STATE LIBRARY
One Capitol Mall
Little Rock, AR 72201
(501) 371-2326

AUBURN UNIV. AT MONTGOMERY LIBRARY
Documents Department
Montgomery, AL 36193
(205) 279-9110, ext. 253

UNIV. OF ALABAMA LIBRARY
Documents Dept.-Box S
University, AL 35486
(205) 348-7369

DEPT. OF LIBRARY, ARCHIVES AND PUBLIC RECORDS
Third Floor-State Cap.
1700 West Washington
Phoenix, AZ 85007
(602) 255-4121

UNIVERSITY OF ARIZONA LIB.
Government Documents Dept.
Tucson, AZ 85721
(602) 626-5233

CALIFORNIA STATE LIBRARY
Govt. Publications Section
P.O. Box 2037
Sacramento, CA 95809
(916) 322-4572

UNIV. OF COLORADO LIB.
Government Pub. Division
Campus Box 184
Boulder, CO 80309
(303) 492-8834

DENVER PUBLIC LIBRARY
Govt. Pub. Department
1357 Broadway
Denver, CO 80203
(303) 571-2131

CONNECTICUT STATE LIBRARY
Government Documents Unit
231 Capitol Avenue
Hartford, CT 06106
(203) 566-4971

UNIV. OF FLORIDA LIBRARIES
Library West
Documents Department
Gainesville, FL 32611
(904) 392-0367

UNIV. OF GEORGIA LIBRARIES
Government Reference Dept.
Athens, GA 30602
(404) 542-8951

UNIV. OF HAWAII LIBRARY
Govt. Documents Collection
2550 The Mall
Honolulu, HI 96822
(808) 948-8230

UNIV. OF IDAHO LIBRARY
Documents Section
Moscow, ID 83843
(208) 885-6344

ILLINOIS STATE LIBRARY
Information Services Branch
Centennial Building
Springfield, IL 62706
(217) 782-5185

INDIANA STATE LIBRARY
Serials Documents Section
140 North Senate Avenue
Indianapolis, IN 46204
(317) 232-3686

UNIV. OF IOWA LIBRARIES
Govt. Documents Department
Iowa City, IA 52242
(319) 353-3318

UNIVERSITY OF KANSAS
Doc. Collect.-Spencer Lib.
Lawrence, KS 66045
(913) 864-4662

UNIV. OF KENTUCKY LIBRARIES
Govt. Pub. Department
Lexington, KY 40506
(606) 257-3139

LOUISIANA STATE UNIVERSITY
Middleton Library
Govt. Docs. Dept.
Baton Rouge, LA 70803
(504) 388-2570

LOUISIANA TECHNICAL UNIV. LIBRARY
Documents Department
Ruston, LA 71272
(318) 257-4962

UNIVERSITY OF MAINE
Raymond H. Fogler Library
Tri-State Regional Documents Depository
Orono, ME 04469
(207) 581-1680

UNIVERSITY OF MARYLAND
McKeldin Lib.-Doc. Div.
College Park, MD 20742
(301) 454-3034

BOSTON PUBLIC LIBRARY
Government Docs. Dept.
Boston, MA 02117
(617) 536-5400 ext. 226

DETROIT PUBLIC LIBRARY
Sociology Department
5201 Woodward Avenue
Detroit, MI 48202
(313) 833-1409

MICHIGAN STATE LIBRARY
P.O. Box 30007
Lansing, MI 48909
(517) 373-0640

UNIVERSITY OF MINNESOTA
Government Pubs. Division
409 Wilson Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 373-7813

UNIV. OF MISSISSIPPI LIB.
Documents Department
University, MS 38677
(601) 232-5857

UNIV. OF MONTANA
Mansfield Library
Documents Division
Missoula, MT 59812
(406) 243-6700

NEBRASKA LIBRARY COMM.
Federal Documents
1420 P Street
Lincoln, NE 68508
(402) 471-2045
(in cooperation with University of Nebraska-Lincoln)

UNIVERSITY OF NEVADA LIB.
Govt. Pub. Department
Reno, NV 89557
(702) 784-6579

NEWARK PUBLIC LIBRARY
5 Washington Street
Newark, NJ 07101
(201) 733-7812

UNIVERSITY OF NEW MEXICO
Zimmerman Library
Government Pub. Dept.
Albuquerque, NM 87131
(505) 277-5441

NEW MEXICO STATE LIBRARY
Reference Department
325 Don Gaspar Avenue
Santa Fe, NM 87501
(505) 827-2033, ext. 22

NEW YORK STATE LIBRARY
Empire State Plaza
Albany, NY 12230
(518) 474-5563

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Wilson Library
BA/SS Documents Division
Chapel Hill, NC 27515
(919) 962-1321

UNIVERSITY OF NORTH DAKOTA
Chester Fritz Library
Documents Department
Grand Forks, ND 58202
(701) 777-2617, ext. 27
(in cooperation with North Dakota State Univ. Library)

STATE LIBRARY OF OHIO
Documents Department
65 South Front Street
Columbus, OH 43215
(614) 462-7051

OKLAHOMA DEPT. OF LIBRARIES
Government Documents
200 NE 18th Street
Oklahoma City, OK 73105
(405) 521-2502

OKLAHOMA STATE UNIV. LIB.
Documents Department
Stillwater, OK 74078
(405) 624-6546

PORTLAND STATE UNIV. LIB.
Documents Department
P.O. Box 1151
Portland, OR 97207
(503) 229-3673

STATE LIBRARY OF PENN.
Government Pub. Section
P.O. Box 1601
Harrisburg, PA 17105
(717) 787-3752

TEXAS STATE LIBRARY
Public Services Department
P.O. Box 12927-Cap. Sta.
Austin, TX 78753
(512) 471-2996

TEXAS TECH. UNIV. LIBRARY
Govt. Documents Department
Lubbock, TX 79409
(806) 742-2268

UTAH STATE UNIVERSITY
Merrill Library, U.M.C. 30
Logan, UT 84322
(801) 750-2682

UNIVERSITY OF VIRGINIA
Alderman Lib.-Public Doc.
Charlottesville, VA 22901
(804) 924-3133

WASHINGTON STATE LIBRARY
Documents Section
Olympia, WA 98504
(206) 753-4027

WEST VIRGINIA UNIV. LIB.
Documents Department
Morgantown, WV 26506
(304) 293-3640

MILWAUKEE PUBLIC LIBRARY
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 278-3000

ST. HIST. LIB. OF WISCONSIN
Government Pub. Section
816 State Street
Madison, WI 53706
(608) 262-4347

WYOMING STATE LIBRARY
Supreme Ct. & Library Bld.
Cheyenne, WY 82002
(307) 777-6344

Order Number Correlation	Report Number Index	Contract Number Index	Subject Index	Personal Author Index	Corporate Author Index